4G LTE eNodeB

Configuration Guide

BaiBLN_3.0

July 2023
Version 1.01

About This Document

This document describes the mainstream applications used for configuring and administering the Baicells eNodeBs (eNBs). The scope of information includes the standard single carrier eNB Graphical User Interface (GUI), as well as the two-carrier eNB capable of operating in Carrier Aggregation (CA) mode or Dual Carrier (DC)/split mode. The target audience is network administrators who are responsible for configuring, monitoring, troubleshooting, and upgrading Baicells eNBs; configuring network interfaces; adding subscribers, and creating service plans.

Separate *documents* are available for specific use cases or to focus on particular deployment scenarios:

- HaloB Solution User Guide
- Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide
- SAS Deployment User Guide
- Local OMC+BOSS
- Local Evolved Packet Core (EPC)

This publication of the guide is written to the following Baicells eNB software version: BaiBLN_3.0 (Nova846).

Terms used in this document or related to Long-Term Evolution (LTE) are listed in alphabetical order and described in *Acronyms and Abbreviations*, which can be found at Baicells.com > Resources > *Documents*.

New in This Release

The following updates have been provided in this release:

- The software migrated from BaiBU_DNB4_2.2 to BaiBLN_3.0 at this release, and all GUIs depicted in this document reflect the BaiBLN_3.0 software.
- References to BaiBS_QRTB software have been updated to BaiBLQ software.
- Enhancements to the *BTS Info / Quick Setting* sub-menu (*section 2.4.2*) allow operators who use the Citizens Broadband Radio Service (CBRS) to configure their CBRS Service Devices (CBSDs) to be served by a Spectrum Access System (SAS) either directly or through a Domain Proxy (DP).
- In the *System > Diagnostics* sub-menu (*section 2.5.5*), the Iperf3 type of diagnostics test was added, and explanations about each type of diagnostic test was also added.
- In the *Network > IPSec/MME Pool* sub-menu, a setting was added to allow users to bind the TR-069 and the Internet Protocol Security (IPSec) interface (*section 2.6.2.1*).
- A subscription data list was added to the *BTS Setting > HaloB Setting* sub-menu (*section 2.7.4*).
- Three new advanced settings were added to the *LTE Setting > Advanced* sub-menu: Signal Trace Setting (*section 2.8.7.2*), PCI Conflict Detection (*section 2.8.7.3*), and UL 64 QAM Setting (*section 2.8.7.14*).
- The *LTE Setting > Spectrum Scanning* sub-menu was added (*section 2.8.9*).

Copyright Notice

Disclaimer

All products, services, and features bought from Baicells Technologies are subject to the constraints of the company's business contract and terms. All or part of the products, services, or features described in this document might not be your specific Baicells network. Unless stated in the contract, Baicells Technologies does not make any explicit or default statement or guarantee about the contents of this document.

Unless stated otherwise, this document serves only as a user guide, and all descriptions/ information/ suggestions mean no guarantee, neither explicit nor implicit.

The information in this document is subject to change at any time without notice. For more information, please consult with a Baicells technical engineer or the support team. Refer to the "Contact Us" section.

Revision Record

Date	Version	Description	SMEs/Contributors
7-Jul-2023	V1.01	Created a new eNodeB Configuration Guide with focus on eNBs running BaiBLN software* only. *Refer to the eNodeB Configuration Guide found at Baicells.com > Resources > *Documents* for content related to eNBs running BaiBS_RTS, BaiBS_RTD, and BaiBLQ software.	Anna Ch, Blake Volk

Resources

- **Documentation** - Baicells product datasheets and technical manuals can be found at Baicells.com > Resources > *Documents*.
- **Support** - Open a support ticket, process an RMA, and the Support Forum are at Baicells.com > *Support*.

Contact Us

Baicells Technologies
5700 Tennyson Pkwy, #300, Plano, TX 75024, USA
Phone: +1-888-502-5585
Email: *sales_na@baicells.com* for North America or *contact@baicells.com* for all other regions
Website: *baicells.com*

Table of Contents

List of Figures

List of Tables

1. Introduction

The Baicells products give network operators the ability to offer internet service to subscribers using LTE-based broadband wireless access. In a standard configuration, the key components include User Equipment (UE), eNodeB (eNB) radio access network equipment, and cloud-based core functions and network/subscriber management applications (Figure 1-1). A subscriber connects a laptop, tablet, or other smart device through the UE – also called Customer Premise Equipment (CPE) – which connects wirelessly to an eNB. The eNB communicates with the LTE backhaul network.

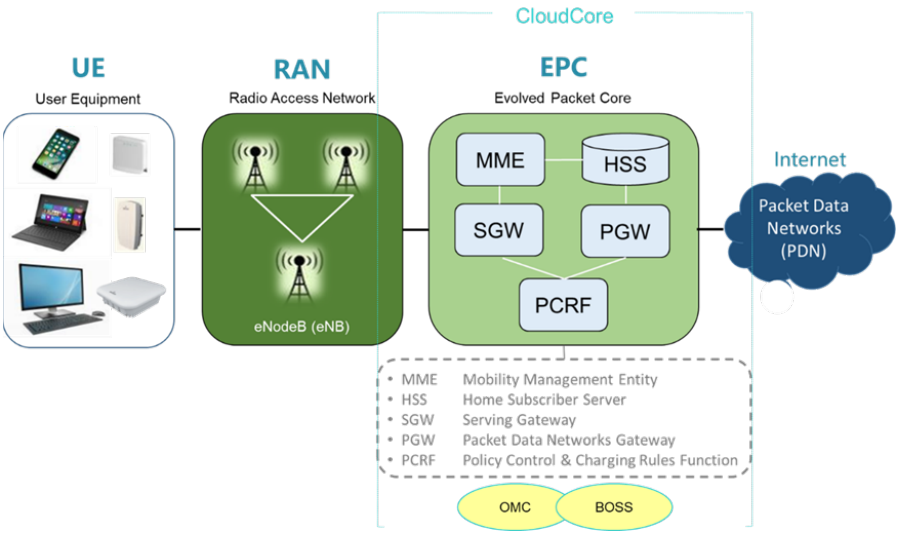
NOTE: The terms UE and CPE have the same meaning and are used interchangeably in this document.

The available Operations, Administration, and Management (OAM) applications include an eNB GUI, a CPE GUI, the Baicells CloudCore Operations Management Console (OMC), and the Baicells CloudCore Business and Operation Support System (BOSS). The eNB GUI for eNBs running BaiBLN software is documented in this guide, and the other eNB GUIs and apps are documented in:

- eNodeB Configuration Guide - BaiBS_RTS and BaiBS_RTD Software
- eNodeB Configuration Guide - BaiBLQ Software
- Atom CAT4 CPE Configuration Guide
- Atom CAT6/CAT15 CPE Configuration Guide
- CloudCore Configuration & Network Administration Guide

The eNB GUI and the CPE GUI are used to configure and manage individual devices. The CloudCore apps may be used to configure and manage all of the operator's network devices across multiple sites through the OMC and all of the subscribers and services plans through BOSS. Baicells charges a monthly CloudCore usage fee based on the number of active users. CloudCore includes not only management apps but also provides the core LTE network functions that are shown in Figure 1-1. Private network solutions such as Local EPC and Local OMC+BOSS are available.

Figure 1-1: Standard Baicells LTE Network



Many of the equipment and network interface parameters are preconfigured with recommended default settings from the factory. However, every field and operation is explained and illustrated in this guide to allow each operator the flexibility to use the Baicells CloudCore-based solution to meet their unique requirements.

2. eNB GUI

References: *Nova846 Outdoor 8x5W Two-Carrier TDD eNodeB Installation Guide* and *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*

The eNBs running BaiBLN 3.0 software version can be configured as single-carrier or two-carrier eNBs capable of operating in Carrier Aggregation (CA) mode or Dual Carrier (DC)/split mode. Any major differences for non-standard or two-carrier configurations are noted. Not all menus and fields are applicable to every eNB model or deployment scenario. Specific documents that are available for such exceptions, for specific use cases, or to focus on particular deployment scenarios are cited.

NOTE: Certain fields are used to differentiate Cell 1 and Cell 2 when the eNB is configured for DC mode, and are labeled "Cell1" and "Cell2" throughout this document.

2.1 Computer Requirements

Refer to Table 2-1 for the minimum requirements of the computer that you use to launch the eNB GUI.

Table 2-1: Computer Requirements

Item	Description	
CPU	Higher than Intel Core 1GHz	
Memory	Greater than 2G RAM	
Hard Disk	No less than 100 MB space available	
Ethernet port	10/100/1000 adaptive Ethernet interface	
Operating System	Microsoft: Windows XP, Windows Vista, Windows 7, or higher	Mac: MacOSX 10.5 or higher
Screen Resolution	Higher than 1024 x 768 pixels	
Browser	Google Chrome 9+, Internet Explorer 7.0+, Mozilla Firefox 3.6+	

You can launch the eNB GUI through a Web address (discussed in *section 2.2*). If you are on-site you can connect a computer directly to the eNB unit's Local Maintenance Terminal (LMT), which is the MGMT/LAN port Before launching the GUI, you need to set up the computer's Internet Protocol (IP) address to connect the client to the server, e.g.:

1. In Windows 7, select *Start > Control Panel*, and in the pop-up dialogue window click on *Network and Internet*.
2. Click on *View network status and tasks*, and then click on *Local Connectivity*.
3. In the dialogue window labeled *Status of Local Connectivity*, click on *Properties*. This action opens the *Properties of Local Connectivity* dialogue window.
4. Select *Internet Protocol Version (TCP/IPV4)*, and click on *Properties* (Figure 2-1).

Figure 2-1: Internet Protocol Version (TCP/IPV4)

Either *Obtain an IP address automatically* and proceed to *step 6*, or *Use the following IP address* and follow *step 5* and *step 6*. If the option for obtaining the IP address automatically fails, you need to set up the IP address manually.

5. Use the following IP address option: Input the IP address, subnet mask, and default gateway, where:

- IP address is **192.168.150.xxx** (xxx is a number from 100 to 254).
- Subnet mask is **255.255.255.0**.
- Default gateway is **192.168.150.1**.

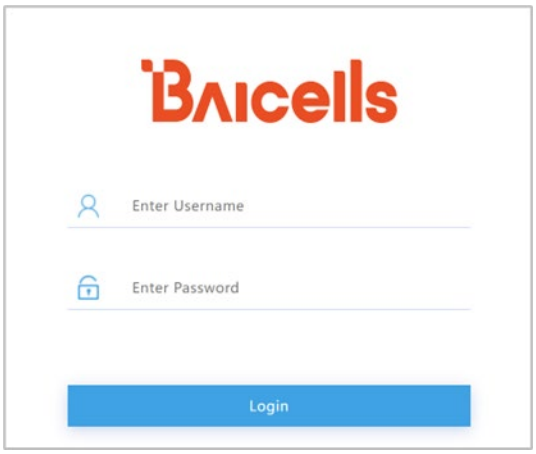
6. Execute ping 192.168.150.1 in the command dialogue window and check whether the connection between the local (client) computer and the server is working.

2.2 Launching the GUI

To launch the GUI, open a Web browser and go to *http://192.168.150.1*. At the *Login* dialogue window (Figure 2-2), enter **admin** for both the default name and password.

NOTE: For security reasons, you should change the password after you first log in rather than leaving the default admin name and password. Refer to *section 2.5.4* of this document.

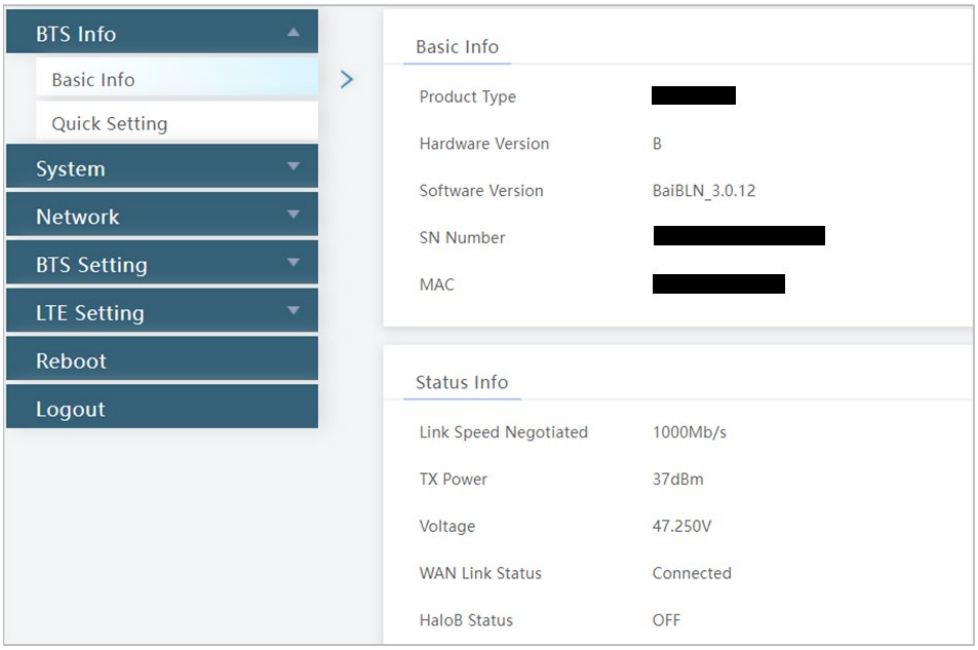
Figure 2-2: Login



The GUI home page displays and shows the navigation pane on the left (example in Figure 2-3). The menus may vary by hardware model, software version, and eNB operating mode.

Use any vertical/horizontal scroll bars that display to see all of a menu's fields. Vertical scroll bars are usually on the right side of the display. Horizontal scroll bars are usually at the bottom of the display.

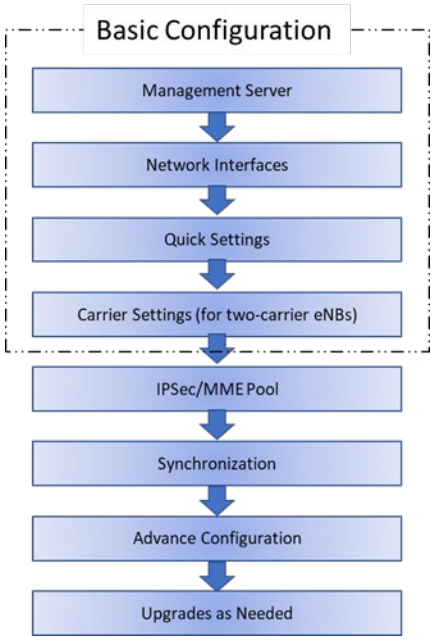
Figure 2-3: Home Page



2.3 Configuration Flow

This document is organized around the visual flow of the GUI menus and fields. However, during initial eNB installation and configuration, perform the basic configuration steps in the order shown in Figure 2-4.

Figure 2-4: Initial eNB Configuration Flow



2.4 BTS Info

2.4.1 Basic Info

The *BTS Info > Basic Info* sub-menu contains several fields that provide essential eNB operational information and is like a dashboard for the eNB. The *Basic Info* pane shows the basic information such as the product type, hardware and software version, device serial number and Message Authentication Code (MAC) address.

The *Status Info* pane shows information such as negotiated link speed, transmit power, voltage, Wide Area Network (WAN) link status, whether or not the HaloB function is enabled, eNB status, whether or not the cell is active, if the eNB has a connection to the Mobility Management Entity (MME) in the core, if the device is connected to the OMC, what the IPSec tunnel connection status is, etc. The fields that display depend on the hardware model, software version, and eNB operating mode. For example, if you were running the eNB in HaloB mode, the field *HaloB Status* would display *ON* in the *Status Info* pane.

The *UE Status* pane displays the number of CPEs that are attached to the eNB and information such as the identity number, downlink and uplink rates, etc.

The settings for many of these fields are configured in other GUI menus, which are all described in this document. The *BTS Info > Basic Info* sub-menu is shown in Figure 2-5 and the fields are described in Table 2-2.

The eNB GUI refreshes the basic information every 15 seconds.

Figure 2-5: Basic Info

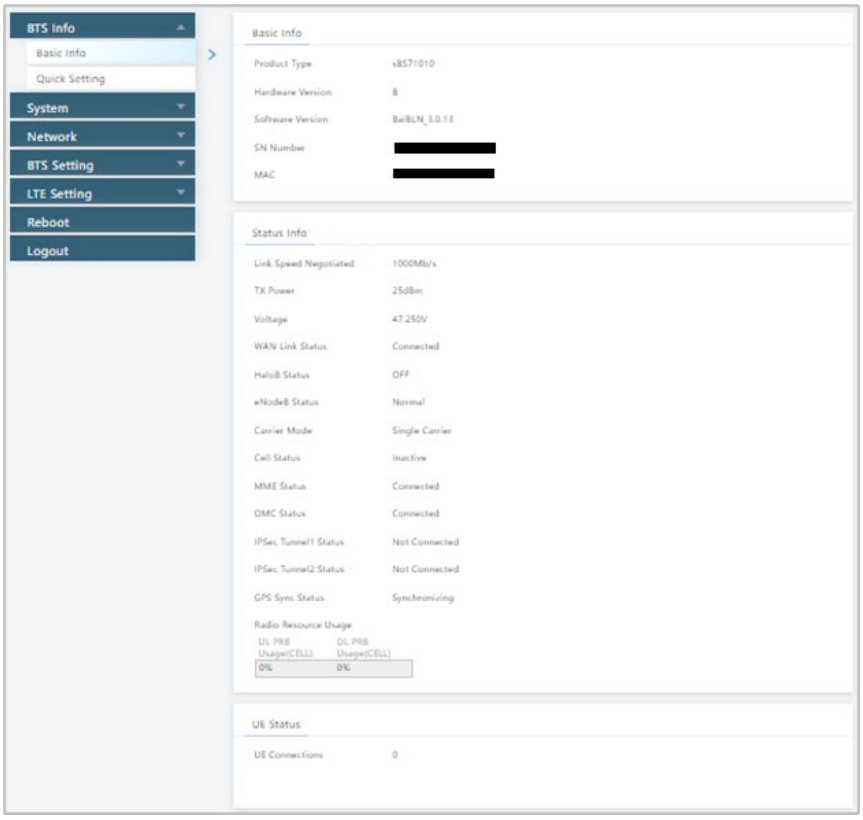


Table 2-2: Basic Info Fields

Field Name	Description
Basic Info	
Product Type	The eNB model.
Hardware Version	The version number of the eNB hardware.
Software Version	The version number of the operating software running on the eNB.
SN Number	Serial Number identifier for the eNB.
MAC	Data Link layer Media Access Control address for the eNB.
Status Info	
Link Speed Negotiated	Data rate negotiated between the eNB and the WAN interface.
TX Power	Transmit (Tx) power is the amount of radio frequency (RF) power (in Watts) that the CPE produces. Unit of measurement is dBm.
Voltage	Voltage draw from power source.
WAN Link Status	Status of link between eNB and WAN (external) interface: Connected/Not connected.
HaloB Status	Indicates HaloB mode status (disable or enable) when the HaloB licensed feature is applied to the eNB.
eNodeB Status	Status of eNodeB (Active or Inactive).
Carrier Mode	Indicates what carrier mode the eNB is operating in as specified in the BTS Setting > Carrier Setting sub-menu. Options are Single Carrier and Dual Carrier (with Carrier Aggregation enabled or disabled). Refer to *section 2.7.6* for more information.
Cell Status	Active or Inactive. When the eNB is operating (transmitting and receiving signals), the status is active. If not, the status is reported as inactive. NOTE: A two-carrier eNB operating in Dual Carrier (DC)/split mode displays Cell 1 and Cell 2 data. Refer to the *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*.
MME Status	MME status is connected or not connected to the eNB. The LTE MME is responsible for initiating paging and authentication of mobile devices. The operator may have more than one MME in the network. NOTE: This field will not appear in HaloB mode.
OMC Status	Status of the link between the eNB and the Baicells Operations Management Console is either connected or not connected.

Field Name	Description
IPSec Status	The Internet Protocol Security gateway is connected or not connected to the eNB. The operator may have more than one IPSec gateway. The system enables the IPSec by default. In the presence of a security gateway, the security protocols are provided in the network layer to ensure the safety of the message transmission. NOTE 1: This field will not appear in HaloB mode. NOTE 2: A two-carrier eNB operating in Dual Carrier (DC)/split mode displays Cell 1 and Cell 2 data. Refer to the *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*.
GPS Sync Status	The eNB is either synchronized or not synchronized with other eNBs in the area. Refer to *section 2.7.3* for more information.
Carrier Mode	Indicates what carrier mode the eNB is operating in as specified in the *BTS Setting > Carrier Setting* sub-menu. Options are Single Carrier and Dual Carrier (with Carrier Aggregation enabled or disabled). Refer to *section 2.7.6* for more information.
Radio Resource Usage	
UL PRB Usage	Shows the percentage of available Physical Resource Blocks being used in the uplink. NOTE: A two-carrier eNB operating in Dual Carrier (DC)/split mode displays Cell 1 and Cell 2 data. Refer to the *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*.
DL PRB Usage	Shows the percentage of available Physical Resource Blocks being used in the downlink. NOTE: A two-carrier eNB operating in Dual Carrier (DC)/split mode displays Cell 1 and Cell 2 data. Refer to the *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*.
UE Status	
UE Connections	Number of CPEs currently connected to the eNB; if at least one, additional fields display.
UE ID	The CPE identification number assigned by the system.
IMSI	The International Mobile Subscriber Identity (IMSI) number. An IMSI is used to identify the user of a cellular network and is a unique identification associated with all cellular networks.
LGW MAC	The MAC address of the local area network gateway.
IP	Internet Protocol address for the eNB.
PORT	Port number assigned to the CPE to allow remote logins. For example, type in the eNB <IP address>:5<last 4 digits of IMSI>.

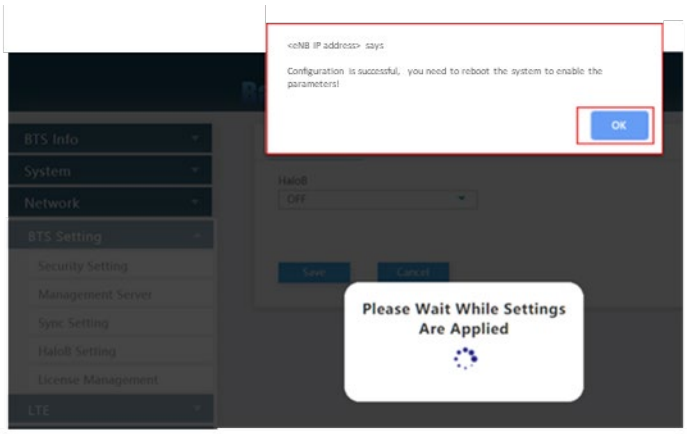
Field Name	Description
UL Throughput (Mbps)	The data throughput rate, in megabits per second (Mbps), of data transmitted uplink by the CPE to the eNB.
DL Throughput (Mbps)	The data throughput rate, in megabits per second (Mbps), of data transmitted downlink by the eNB to the CPE.
ULSINR	Uplink Signal-to-Interference-Plus-Noise Ratio (ULSINR) describes the signal strength of the CPE's signals to the eNB in comparison with other interfering signals or background noise, expressed in dB. The range is 0–30 dB.
DLCQI	Downlink Channel Quality Indicator indicates how good or bad the communication channel quality is for data being transmitted from the eNB to the CPE. CQI is a combination of SNR, SINR, and SNDR. The value range is 1–15.
ULMCS	Uplink Modulation and Coding Scheme is a numerical index based on Orthogonal Frequency Division Multiplexing (OFDM) that represents the maximum data rate the CPE can achieve when transmitting data over-the-air to the eNB. The MCS index value comprises several variables, including channel width, modulation type, coding rate, and spatial streams.
DLMCS	Downlink Modulation and Coding Scheme – see description for "ulmcs" above, which in this case pertains to the downlink
Uplink BLER	Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Uplink BLER represents a ratio of the number of erroneous data blocks received to the total number of blocks sent from CPE to eNB.
DownLink BLER	Block Error Ratio (BLER) is a measure of how successful a data transmission is over-the-air at the Physical/MAC layer level. Downlink BLER is a ratio of the number of erroneous data blocks received to the total number of blocks sent from the eNB to the CPE.
Pathloss&Interference(dB)	Reports the reduction in power density (attenuation) as the wireless signal propagates through space. The pathloss value impacts the overall RF link budget. An RF link budget is an accounting of all the gains and losses from the transmitter, through the medium to the receiver.

Switching to a different operating mode requires a reboot of the eNB.

A message displays stating to please wait while settings are applied. When the message displays confirming the configuration is successful, click *OK* to initiate the reboot (Figure 2-6). Refer to the following documents that are specific to non-standard operating modes:

- *HaloB Solution User Guide*
- *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*
- *SAS Deployment User Guide*

Figure 2-6: Message



2.4.2 Quick Setting

The *Quick Setting* fields must be configured for cell parameters and transmission information. When an eNB is attaching to the core network through the Baicells CloudCore, the *PLMN* field must be set to **314030.** When the eNB connects to CloudCore, the *MME IP* address fields are set to **10.3.0.9** and **10.5.0.9**. Check to make sure the eNB has obtained the two MME addresses.

NOTE: If the eNB is set to single carrier mode, one cell is configured. If it is set to Dual Carrier (DC)/split mode, two cells are configured, and some fields displays Cell1 and Cell2 information. Refer to the *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide.*

In addition, the *BTS Info > Quick Setting* sub-menu contains several key parameters to support Citizens Broadband Radio Service (CBRS) and the shared Spectrum Access System (SAS) when SAS is enabled in the *LTE Setting > SAS Settings* sub-menu. *Section 2.8.8* provides a brief introduction to SAS, and the *SAS Deployment User Guide* provides all the detailed information about these key parameters, SAS requirements, and SAS-specific configurations for these eNBs.

The *BTS Info > Quick Setting* sub-menu is shown in Figure 2-7 and the fields are described in Table 2-3. The data presented is with SAS-related fields enabled.

For most *Quick Setting* parameter changes, you must perform a reboot of the eNB for the changes to take effect.

Figure 2-7: Quick Setting

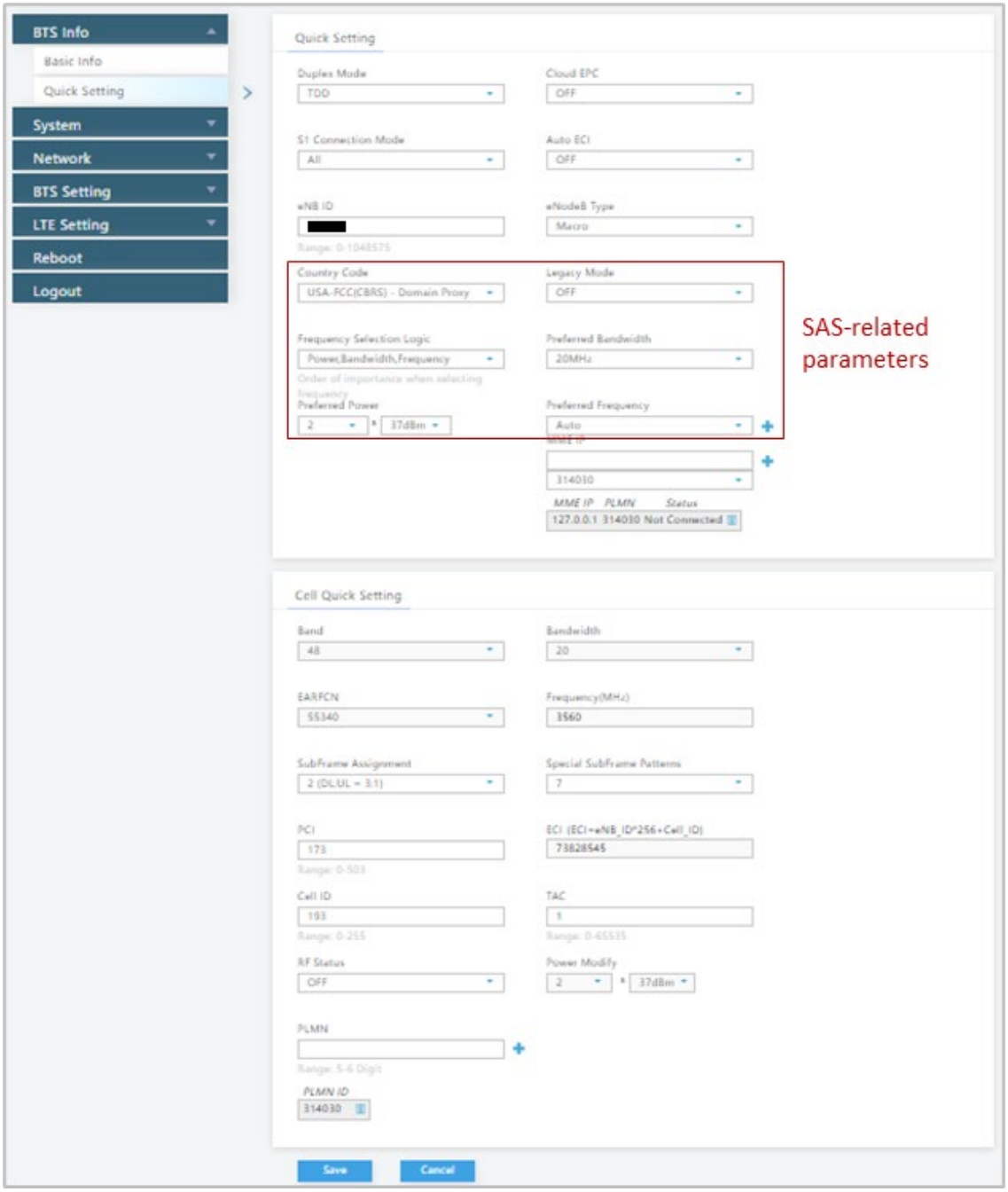


Table 2-3: Quick Setting Fields

Field Name	Description
Quick Setting Pane	
Duplex Mode	Preset field - cannot be configured at this time. Either Time Division Duplexing (TDD) or Frequency Division Duplexing (FDD) depending on model and country.

Field Name	Description
Cloud EPC	The Baicells CloudCore Evolved Packet Core (EPC) is either *ON* or *OFF*. When you enable it (*ON*), the fields for *eNB ID* and *MME IP* (*Quick Setting* pane) and *Frequency(MHz)*, *ECI*, *CELL ID*, *TAC*, and *PLMN* (*Cell Quick Setting* pane) are automatically assigned and are greyed out. When you disable the Cloud EPC setting (*OFF*), the greyed out fields are unlocked again. Also, when you change the Cloud EPC setting, a **reboot** of the eNB is required. NOTE: This field will not display in HaloB mode.
S1 Connection Mode	The connection mode of the S1 interface between the eNB and the core network. • One: The eNB connects only to the first MME. • All: The eNB connects to all MMEs configured. NOTE: This field will not display in Cloud EPC mode.
Auto ECI	E-UTRAN Cell Identity (ECI) is generated automatically. E-UTRAN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access Network.
eNB ID	The identify assigned to the eNB. The range is 0–1048575. NOTE: The eNB ID is generated automatically if the *Auto ECI* field is set to *ON*.
eNodeB Type	The eNB type (Macro or Home). • Macro: The eNB is covering a large cell area and the transmission power in on the higher end of the power range. • Home: The eNB's transmission power is much lower than Macro and covers a smaller area.
Country Code	Used to select operating mode: • USA-FCC(CBRS) - Direct SAS: Used to enable the eNB to operate in CBRS SAS mode • USA-FCC(CBRS) - Domain Proxy: Used to enable the eNB to operate in CBRS SAS mode • Other: Used to operate in normal mode. NOTE: Refer to the *SAS Deployment User Guide* for more information.
Legacy Mode	Used to enable CPEs only supporting Bands 42 or 43 to connect to a Band 48 eNB. The default is OFF. NOTE: This field will not appear unless SAS is enabled.

Field Name	Description
Frequency Selection Logic	Used to configure preferred frequencies, channel bandwidth, and power when SAS is enabled. NOTE: This field will not appear unless SAS is enabled. Refer to the *SAS Deployment User Guide* for more information.
Preferred Bandwidth	Used to set the preferred bandwidth for the eNB. NOTE: This field will not appear unless SAS is enabled. Refer to the *SAS Deployment User Guide* for more information.
Preferred Power	Used to set the preferred power for the eNB. The preferred power is the total TX power (in dBm) being transmitted per carrier. NOTE: This field will not appear unless SAS is enabled. Refer to the *SAS Deployment User Guide* for more information.
Preferred Frequency	Used to set the preferred frequency for the eNB. More than one preferred frequency can be added, and each frequency's priority can be set. NOTE: This field will not appear unless SAS is enabled. Refer to the *SAS Deployment User Guide* for more information.
MME IP	This field appears for eNBs operating in standard mode. Enter the IP address of the MME. If you are using the Baicells CloudCore, the MME IP addresses are 10.3.0.9 and 10.5.0.9. NOTE: This field will not appear in HaloB mode.
Cell Quick Setting Pane	
Band	The eNB's operating frequency band with a default setting of band 48.
Bandwidth	For TDD mode, the channel bandwidth the eNB may use: 5, 10, 15, or 20 MHz. Applies to both uplink and downlink. The default is 20 MHz.
EARFCN	EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number. Used to set the absolute radio frequency channel number as allocated by the operator. The range is 55340–56640 or custom (which applies to ranges in B41 and B48. NOTE: If SAS is enabled, the EARFCN will be assigned by the SAS vendor and the field will be greyed-out. Refer to the *SAS Deployment User Guide* for more information.

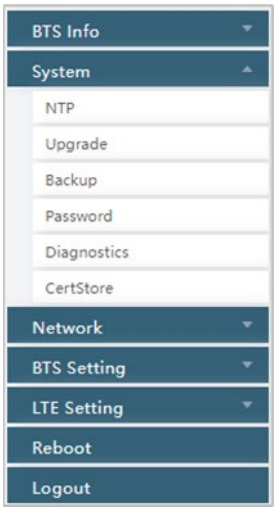
Field Name	Description
Frequency(MHz)	The eNB's operating frequency (MHz) as selected by the operator. Range depends on the eNB hardware model, country code, and whether or not SAS is enabled. Example for B48: 55240 (3550 MHz) to 56739 (3700 MHz). NOTE: If SAS is enabled, the frequency is assigned by the SAS vendor and the field is greyed out. Refer to the *SAS Deployment User Guide* for more information.
SubFrame Assignment	Downlink (DL) and uplink (UL) subframe configuration, either 1, 2,or 6 where: 1 = DL:UL is 2:2 transmission ratio 2 = DL:UL is 3:1 transmission ratio (default) 6 = DL:UL is 3:5 transmission ratio Refer to the BaiTip on this setting: *https://community.na.baicells.com/t/baitip-of-the-day-december-14th-2016-subframes-and-special-subframes/163*.
Special SubFrame Patterns	This is a standard LTE setting that pertains to synchronization of downlink and uplink timing. The guard period between switching from DL to UL or UL to DL determines the maximum supportable cell size. The guard period has to be large enough to cover the propagation delay of DL interferers. The range is 5 and 7. The default setting is 7.
PCI	Physical Cell Identification (PCI) allocated by the operator. The range is 0–503. PCI is an essential Layer 1 cell identity for each cell site in the network. Planning PCIs is crucial for Quality of Service (QoS). NOTE: Baicells does not use and does not work with PCI 0.
ECI	Unique identification number for the Cell ID. The Cell ID + the eNB ID x 256 comprises the ECI, which identifies a cell site in the network. Example of how Cell ID is used in calculating the ECI using ENB ID*256+cell ID: ECI=256055 if ENB ID=1000 and Cell ID=55. NOTE: The value of ECI is generated automatically by the eNB if the *Auto ECI* field is set to *ON*.
Cell ID	Unique identification number for the Cell ID. Range from 0 to 255. NOTE: The value of Cell ID is generated automatically by the eNB if the *Auto ECI* field is set to *ON*.

Field Name	Description
TAC	Tracking Area Code (TAC) for where the eNB is located. The TAC is used to determine the range of the paging information. Use a number between 0–65535. The default is 1.
RF Status	Enable (*ON*) or disable (*OFF*) the eNB's RF antenna to allow it to transmit and receive or to keep it from transmitting and receiving. The default is *ON*.
Power Modify	Output power on each port, typically left with the default values. 30 dBm x2 = 33 dBm. Every 3 dB doubles the power. This field may be used in situations where you need to reduce the output power, such as testing the eNB before installing it on a tower; restricting the eNB output to reduce interference with other eNBs in the same geographical area; or staying within Effective Isotropic Radiated Power (EIRP) rules. NOTE: If SAS is enabled, the power setting will be assigned by the SAS vendor. Refer to the *SAS Deployment User Guide* for more information.
PLMN	The numerical identifier for the operator's Public Land Mobile Network (PLMN) for this cell. Must be a 5- or 6-digit number. If you are using the Baicells CloudCore, you must enter **PLMN = 314030.**

2.5 System

The *System* menu (Figure 2-8) is used to configure Network Time Protocol (NTP), perform software upgrade/rollback, backup files and logs, import configuration files or restore default configurations, reset the password (for the eNB GUI), and perform diagnostics. The *CertStore* sub-menu is used for uploading eNB certificates, e.g., licensing files.

Figure 2-8: System Menu



2.5.1 NTP

The operator may configure more than one NTP server to provide synchronized time-of-day to the eNB. The *System > NTP* sub-menu is shown in Figure 2-9 and the fields are described in Table 2-4.

Figure 2-9: NTP

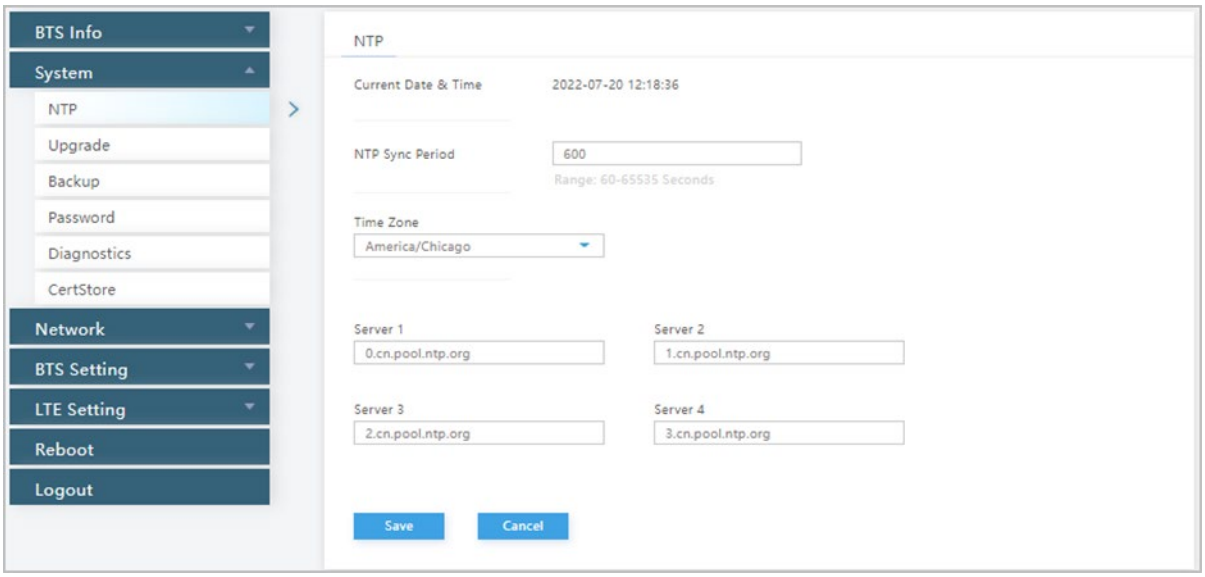


Table 2-4: NTP

Field Name	Description
Current Date & Time	Displays the current date and time that the eNB is using.
NTP Sync Period	Network Time Protocol interval for synchronizing between the eNB and the primary NTP server. The range is 60–65535 seconds. The default is 600 seconds.
Time Zone	The time zone for where the eNB is located.
NTP Servers – Server 1	Primary NTP server IP address.
Server 2	Optional: Slave NTP server IP address.
Server 3	Optional: Slave NTP server IP address.
Server 4	Optional: Slave NTP server IP address.

2.5.2 Upgrade

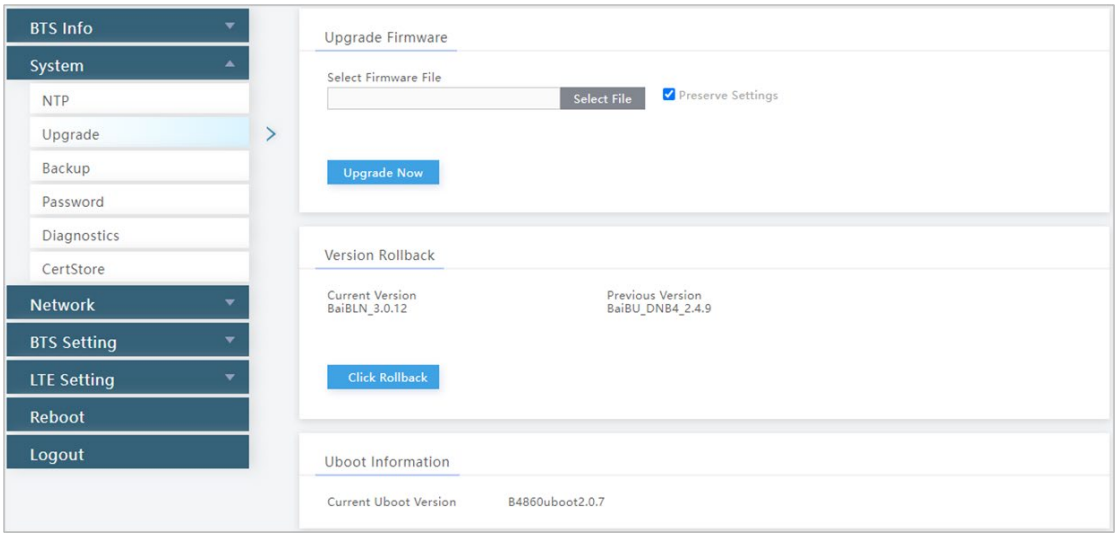
Use the *System > Upgrade* sub-menu to upgrade or downgrade (rollback) the eNB software, and to view Uboot information (Figure 2-10).

NOTE 1: The *System > Upgrade* sub-menu option does not display for Cell2 when the eNB is in dual carrier mode.

NOTE 2: Older versions of the eNB GUI may look different. When upgrading from an older version to the latest, the GUI home page and other menus automatically switch over to the new GUI. However, when rolling back from the latest software to a former software version, the home page and other GUI menus do not switch back to the older GUI. In this case you must verify the configuration (e.g., IP address).

NOTE 3: Additional upgrade capabilities, such as upgrading multiple eNBs simultaneously, are available using the OMC. Refer to *CloudCore Configuration & Network Administration Guide*.

Figure 2-10: Upgrade



To initiate a firmware upgrade:

1. Go to *System > Upgrade*.
2. Click *Select File* in the *Upgrade Firmware* pane to display a list of firmware files in the *Select Firmware File* field.
3. Navigate to the .IMG target file you want to import and save to the local computer.
4. Check the *Attempt to Preserve Settings* checkbox if you want to preserve configuration settings.
5. Click *Upgrade Now* in the *Upgrade Firmware* pane.
6. When prompted, click *Proceed*.
7. After the upgrade is completed (about 5 minutes), the eNB performs a reboot.

Caution: The reboot action disrupts eNB service.

To initiate a roll back to the previous software version:

NOTE 1: You can only roll back to the last previous software version.

NOTE 2: Only one roll back operation is permitted for each upgrade.

NOTE 3: After the roll back is completed and the eNB performs a reboot, you can see the change in software version listed in the *BTS Info > Basic Info* sub-menu (*section 2.4.1*).

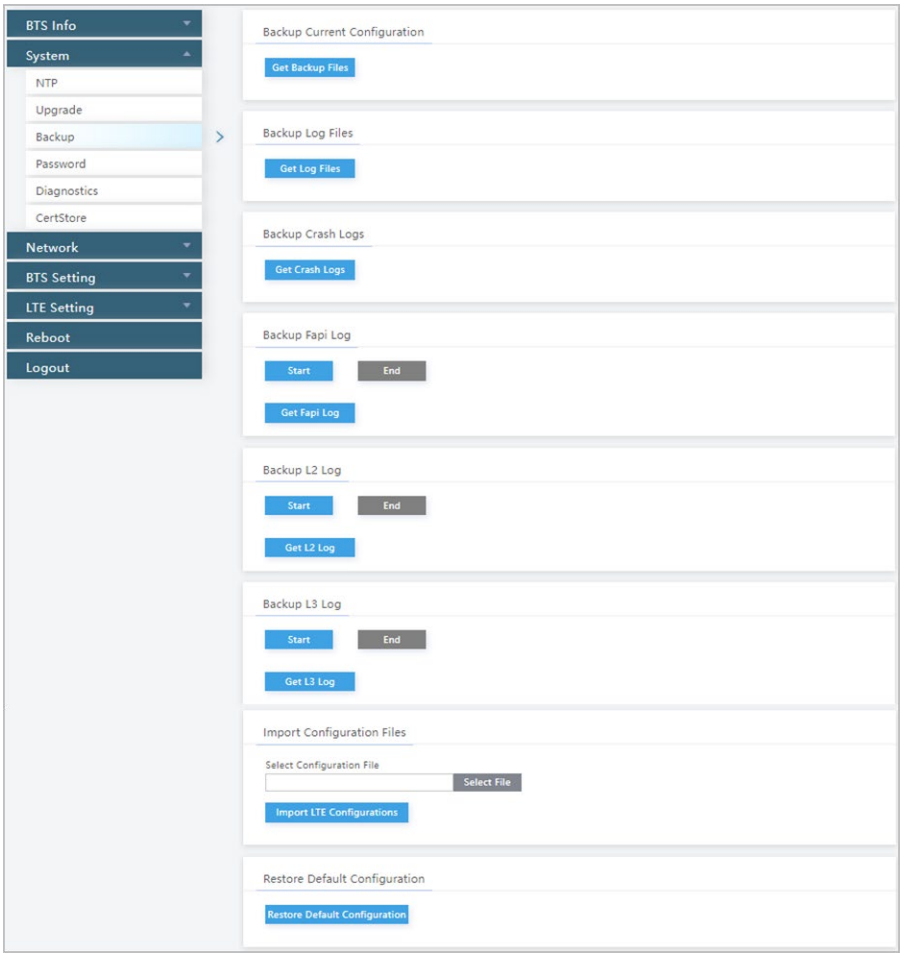
1. Go to *System > Upgrade*.
2. View *Current Version* and *Previous Version* information shown in the *Version Rollback* pane.
3. Click *Rollback* in the *Version Rollback* pane.
4. Click *OK* when prompted if you want to continue with the rollback procedure.
5. After the rollback is completed (about 5 minutes), the eNB performs a reboot.

Caution: The reboot action disrupts eNB service.

2.5.3 Backup

The *System > Backup* sub-menu (Figure 2-11) is used to back up the current configuration, log files, crash logs, Fapi log (R&D-specific logs), and the Layer 2 (L2) and Layer 3 (L3) logs; to import configuration files (e.g., to create a new eNB using the configuration from an existing eNB); or to restore all of the default configuration settings for the eNB.

Figure 2-11: Backup



To initiate a backup of the current configuration:

1. Go to *System > Backup*.
2. Click on *Get Backup Files* in the *Backup Current Configuration* pane. The system displays "Preparing Backup File", and then a folder displays at the lower left side of the display window. The folder label includes the date and time in which the backup was initiated.
3. Click on the folder to open it.
4. Copy (save) the folder to the local computer.

To initiate a backup of log files:

1. Go to *System > Backup*.
2. Click on *Get Log Files* in the *Backup Log Files* pane. The system displays "Preparing Backup File", and then a folder displays at the lower left side of the display window. The folder label includes the date and time in which the backup was initiated.

3. Click on the folder to open it.
4. Copy (save) the folder to the local computer.

To initiate a backup of crash logs:

1. Go to *System* > *Backup*.
2. Click on *Get Crash Logs* in the *Backup Crash Logs* pane. The system displays "Preparing Backup File", and then a folder displays at the lower left side of the display window. The folder label includes the date and time in which the backup was initiated.
3. Click on the folder to open it.
4. Copy (save) the folder to the local computer.

To initiate a backup of the Fapi log:

1. Go to *System* > *Backup*.
2. Click on *Start* in the *Backup Fapi Log* pane. The system displays "Please Wait While Settings Are Applied".
3. When the message in *step 2* closes, click on *End* in the *Backup Fapi Log* pane. The system displays "Please Wait While Settings Are Applied".
4. When the message in *step 3* closes, click on *Get Fapi Log* in the *Backup Fapi Log* pane. The system displays "Preparing Backup File", and then a folder displays at the lower left side of the display window. The folder label includes the date and time in which the backup was initiated.
5. Click on the folder to open it.
6. Copy (save) the folder to the local computer.

To initiate a backup of the L2 log:

1. Go to *System* > *Backup*.
2. Click on *Start* in the *Backup L2 Log* pane. The system displays "Please Wait While Settings Are Applied".
3. When the message in *step 2* closes, click on *End* in the *Backup L2 Log* pane. The system displays "Please Wait While Settings Are Applied".
4. When the message in *step 3* closes, click on *Get L2 Log* in the *Backup L2 Log* pane. The system displays "Preparing Backup File", and then a folder displays at the lower left side of the display window. The folder label includes the date and time in which the backup was initiated.
5. Click on the folder to open it.
6. Copy (save) the folder to the local computer.

To initiate a backup of the L3 log:

1. Go to *System > Backup*.
2. Click on *Start* in the *Backup L3 Log* pane. The system displays "Please Wait While Settings Are Applied".
3. When the message in *step 2* closes, click on *End* in the *Backup L3 Log* pane. The system displays "Please Wait While Settings Are Applied".
4. When the message in *step 3* closes, click on *Get L3 Log* in the *Backup L3 Log* pane. The system displays "Preparing Backup File", and then a folder displays at the lower left side of the display window. The folder label includes the date and time in which the backup was initiated.
5. Click on the folder to open it.
6. Copy (save) the folder to the local computer.

To import a configuration file:

1. Under the *Import Configuration File* pane, click *Select File* and navigate to the file you want to import.
2. Highlight the file, click on *Open*, and then select *Import LTE Configurations.*

To restore the default configuration:

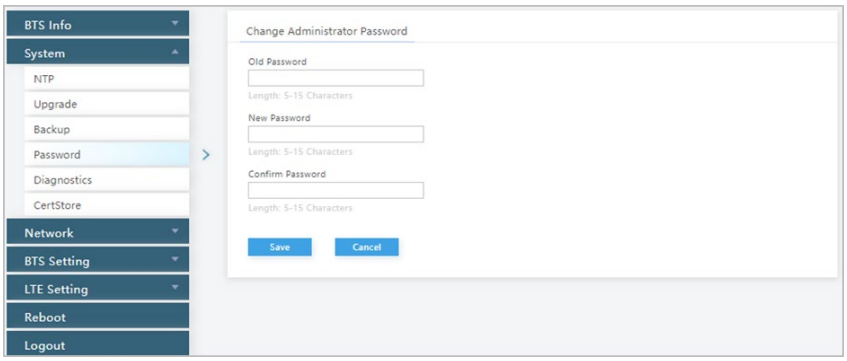
1. Under the *Restore Default Configuration* pane, select *Restore Default Configuration*.
2. The eNB performs a reboot when you restore the default configuration.

Caution: The *Restore Default Configuration* action disrupts eNB service.

2.5.4 Password

The *System > Password* sub-menu (Figure 2-12) is where you change the eNB administrator's (GUI) password. Enter your old password and then enter a new password. Then, re-enter the new password to confirm it and press *Save*. The passwords must be five to 15 characters each.

Figure 2-12: Password



2.5.5 Diagnostics

Use the *Network* > *Diagnostics* sub-menu to perform diagnostics from the eNB, which include ping tests, traceRoute tests, and Iperf3 tests.

A ping test is used to measure the minimum time needed to send the smallest possible amount of data and receive a response. A traceRoute test is a diagnostic test used to troubleshoot network, connectivity, and latency issues. An Iperf3 test is a commonly used network testing tool that can create Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) data streams to measure the throughput of a network that is carrying them. An Iperf3 test can be used not only for testing a network, but also for optimizing it.

Figure 2-13, Figure 2-14, and Figure 2-15 provide examples of the diagnostics parameters for each type of test. Each parameter is described in Table 2-5. After entering the settings, click on *Implement* to run the test.

Figure 2-13: Diagnostics (Ping)

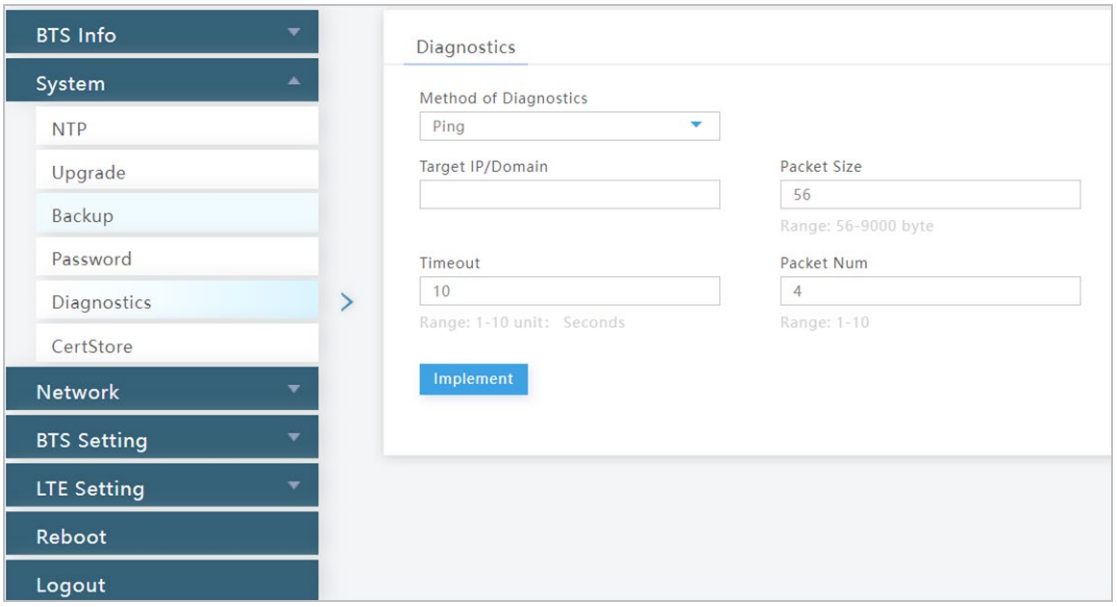


Figure 2-14: Diagnostics (TraceRoute)

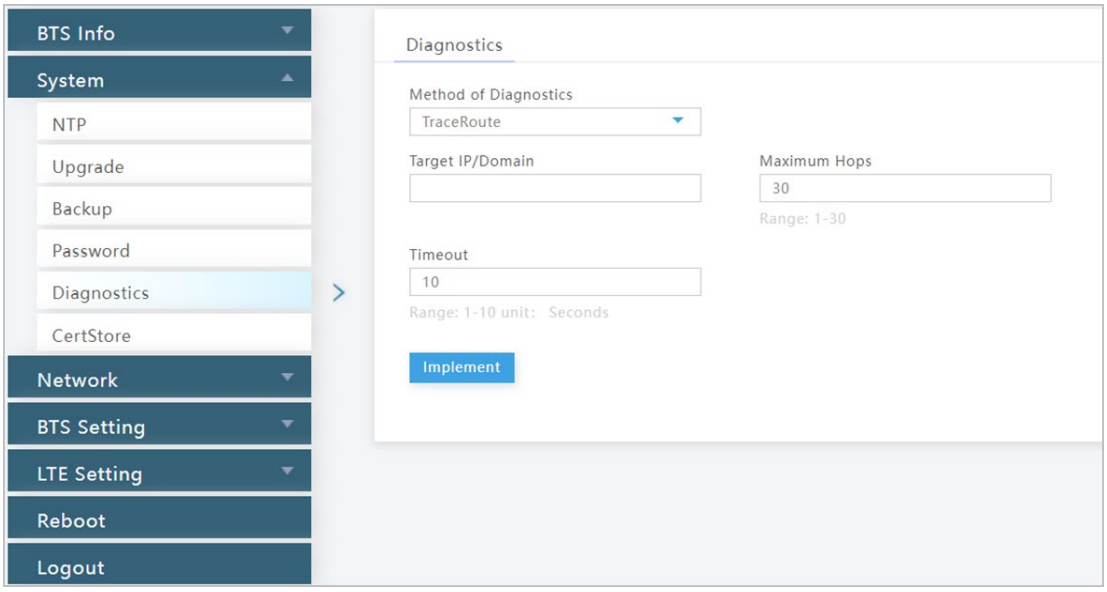


Figure 2-15: Diagnostics (Iperf3)

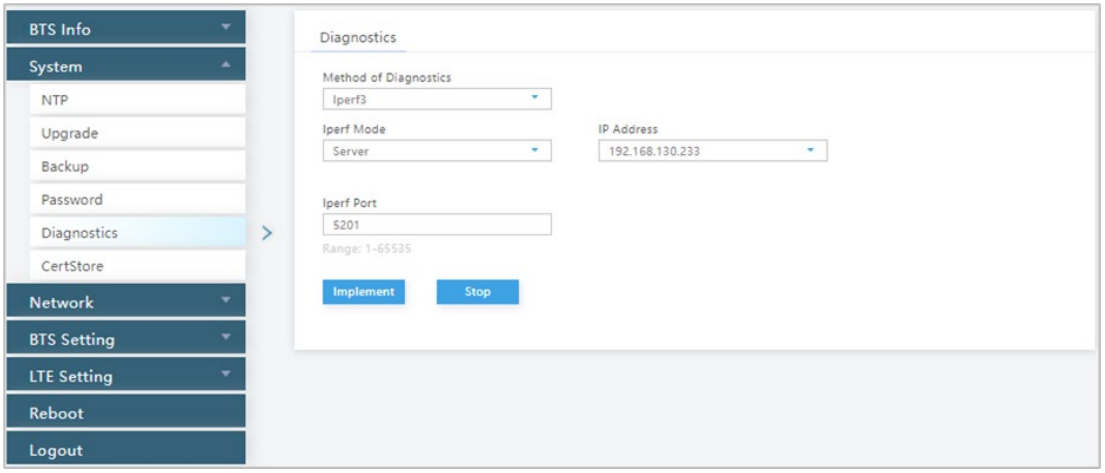


Table 2-5: Diagnostics

Field Name	Description
Method of Diagnostics	Ping, TraceRoute, iPerf3
Ping	
Target IP/Domain	The IP address or domain name of the destination device.
Packet Size	The size of the data packet to be sent. The range is 56–9000 bytes. The default is 56 bytes.
Timeout	The timeout period when the test ends. The range is 1–10 seconds. The default is 10 seconds.
Packet Num	The number of packets to be sent. The range is 1–10. Default is 4 seconds.
TraceRoute	
Target IP/Domain	The IP address or domain name of the destination device.

Field Name	Description
Maximum Hops	The maximum number of hops (network nodes/routers) the packet has to pass before arriving at its destination. The range is 1–30. The default is 30.
Timeout	The timeout period when the test ends. The range is 1–10 seconds. The default is 10 seconds.
Iperf3	
Iperf Mode	iPerf mode: *Server* or *Client*.
Server Mode	
IP Address	IP address of the Iperf being used.
Iperf Port	Port number for the Iperf being used. Range is 1–65535. Default is 5201.
Client Mode (with TCP selected)	
IP Address	IP address of the Iperf being used.
Iperf Port	Port number for the Iperf being used. Range is 1–65535. Default is 5201.
Protocol*	TCP.
Reverse Mode	ON or OFF. Default is OFF.
Time	Range is 1–65535 seconds. Default is 10 seconds.
TCP Window Size	Range is 1–64 KB. Default is 8 KB.
Parallel	Range is 1–10. Default is 1.
Client Mode (with UDP selected)	
IP Address	IP address of the Iperf being used.
Iperf Port	Port number for the Iperf being used. Range is 1–65535. Default is 5201.
Protocol*	UDP.
Reverse Mode	ON or OFF. Default is OFF.
Time	Range is 1–65535 seconds. Default is 10 seconds.
Socket Buffer Size	Range is 700–1600 KB. Default is 1470 KB.
Bandwidth	Range is 1–1000 MB. Default is 1 MB.

*NOTE: The default protocol for an Iperf3 diagnostic test is TCP. If you select UDP as the protocol to be used, both the client and the server must be in UDP mode to successfully perform the tests. You can also perform an Iperf3 diagnostic test by using Secure Shell Protocol (SSH) to log in to the eNB and execute the command “iperf”. The Iperf3 diagnostic tests that can be performed are:

- CPE test (server mode)
- CPE test (client mode using TCP)
- CPE test (client mode using UDP)

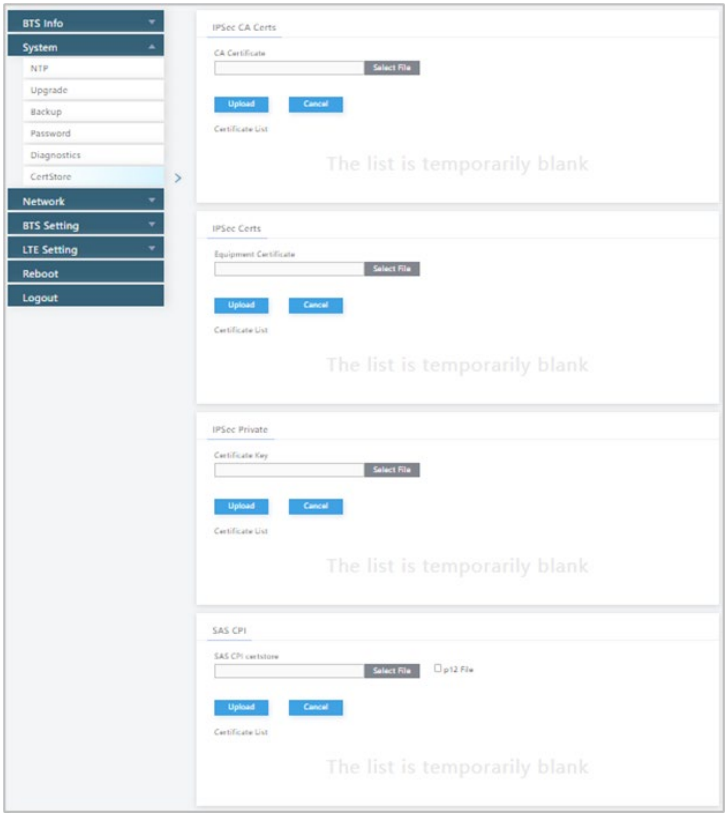
2.5.6 CertStore

The *System > CertStore* sub-menu (Figure 2-16) provides a way to store important files unique to the eNB, such as certificates for internet protocol security. You can also store SAS CPI data. There are four panes in this sub-menu: *IPSec CA Certs*, *IPSec Certs*, *IPSec Private*, and *SAS CPI*. To upload any of the files, simply click *Select File* in the associated pane and navigate to the file to be uploaded. Once you highlight the file, click *Open*.

Then, return to the associated pane and click *Upload.* When the file finishes uploading, the file name displays in the *Certificate List* pane.

NOTE: You must upload the SAS CPI certstore file (as shown in Figure 2-16) before you can register the CBRS Service Devices (CBSDs) with the SAS vendor. For more information, including the two types of upload files that are supported, see the *SAS Deployment User Guide*.

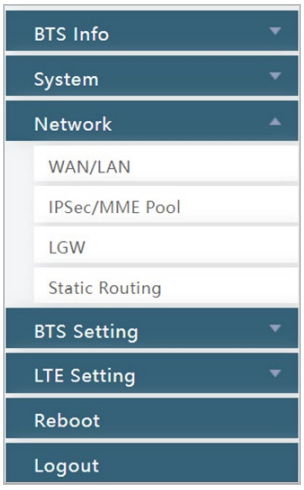
Figure 2-16: CertStore



2.6 Network

The *Network* menu settings are where you configure the network interfaces for the eNB (Figure 2-17).

Figure 2-17: Network Menu



2.6.1 WAN/LAN

The *Network > WAN/LAN* sub-menu (Figure 2-18) is used to configure the default router/Domain Name Services (DNSs), the type of physical connection that the eNB uses to the external network, and the local LAN information. Although not shown in the *Network > WAN/LAN* sub-menu label, the WAN interface supports the configuration of multiple Virtual Local Area Networks (VLANs), which can be used by single-carrier eNBs only.

The WAN interface is an external communication portal (Internet connection) between the eNB's NMS and the MME. The eNB's NMS may be the Baicells OMC or the LTE NMS. The LAN interface is the internal maintenance interface to be used in initialization and isn't needed in normal operation.

The Small Form-Factor Pluggable (SFP) interface is a module that allows you to connect fiber to the eNB, and it's status is shown in the *SFP information* pane.

All of the *Network > WAN/LAN* sub-menu fields are described in Table 2-6.

NOTE : The fields that display in the *Internet/WAN* pane of the *Network > WAN/LAN* sub-menu depend on which protocol you choose from the *Connect Via* drop-down menu that is configurable when you click the settings icon (Figure 2-19).

Figure 2-18: WAN/LAN

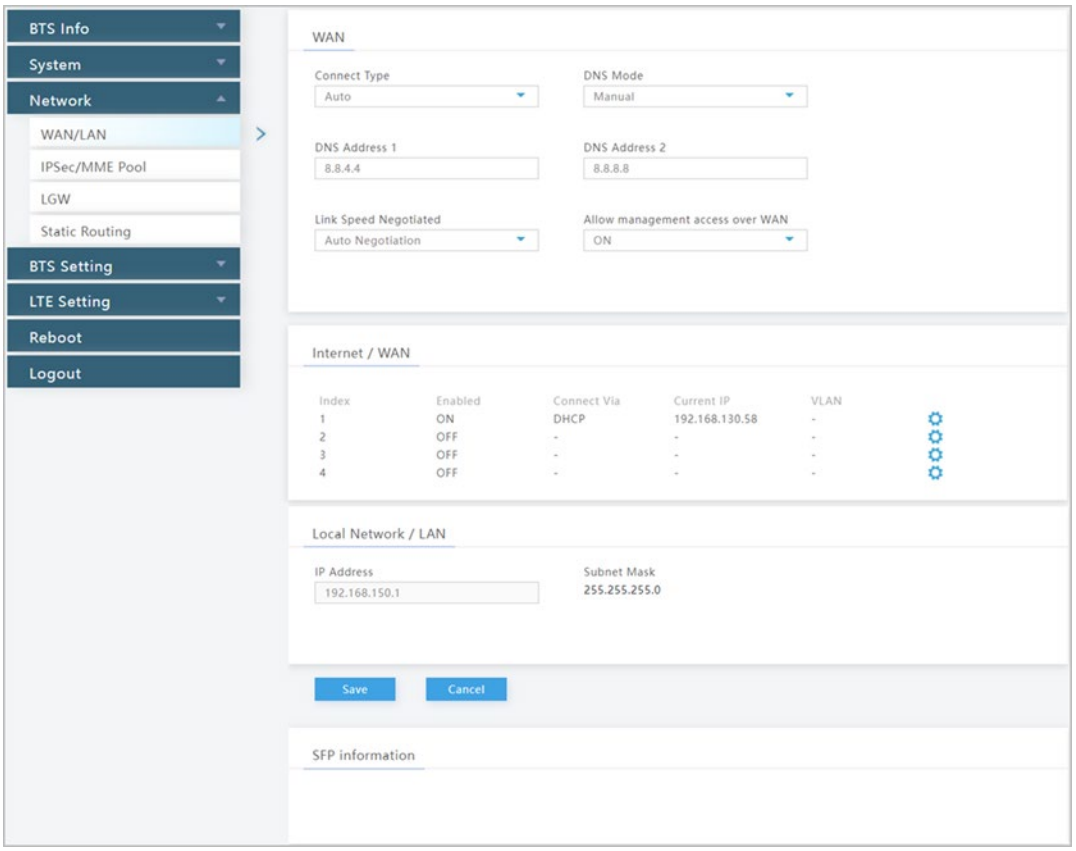
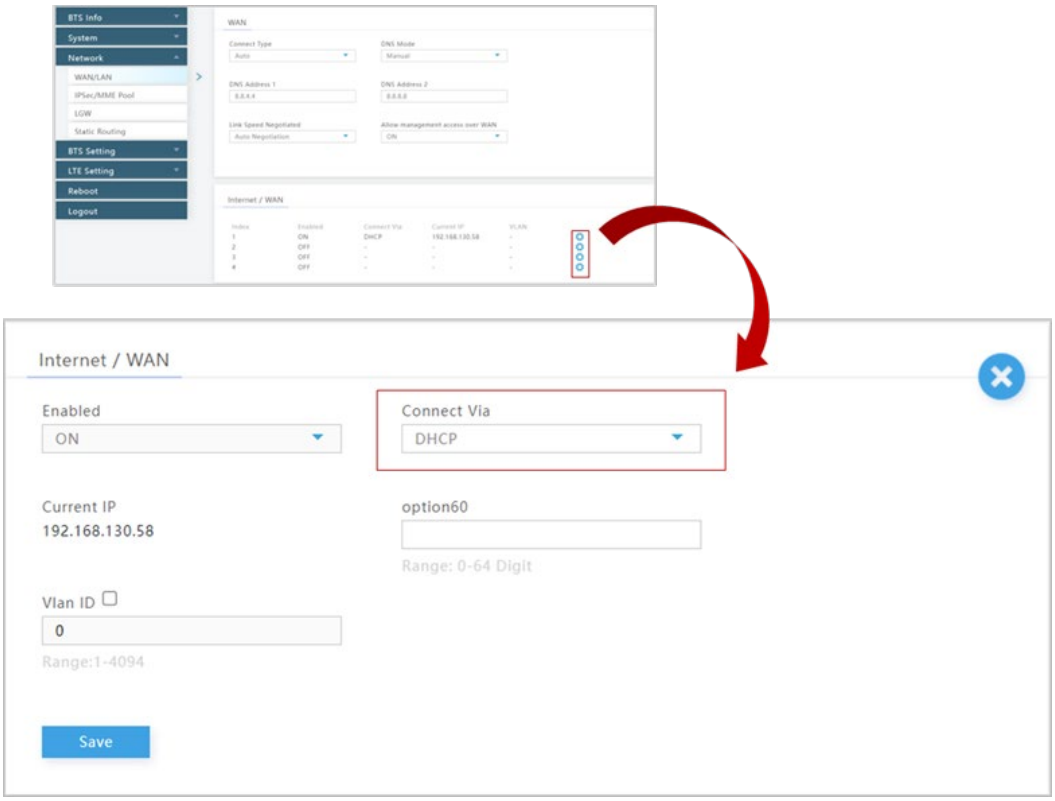


Figure 2-19: Internet/WAN Settings



The physical *Connect Type* may be auto, copper or fiber, and may connect via DHCP or Static IP:

NOTE: The *Connect Via* field drop-down menu shown in Figure 2-19 also lists *IPv6 DHCP* and *IPv6 Static IP* options, which are planned for a future release and not currently supported.

- Dynamic Host Configuration Protocol (DHCP) – the eNB's IP address is obtained dynamically from the local DHCP server. When the *Connect Via* option *DHCP* is selected from the drop-down menu in the *Internet/WAN* pane of the *Network > WAN/LAN* sub-menu, the current DHCP server IP address displays. When DHCP is selected as the connection method, there are no further WAN fields you must configure in this window, although you can choose to configure the *option60* field. The *VLAN IP* is automatically assigned.
- Static IP – when this *Connect Via* option is selected from the drop-down menu in the *Internet/WAN* pane of the *Network > WAN/LAN* sub-menu, the *Current IP*, *Subnet Mask*, and *Gateway* fields display so you can configure them. You can also choose to configure the *Vlan ID* field that displays.

The *Local Network/LAN* pane of the *Network > WAN/LAN* sub-menu is used to configure the LMT port on the eNB. The port may be used during initial eNB setup and configuration. Enter the IP address and subnet mask address for the local network connection. The default LAN IP address is **192.168.150.1**.

To add a VLAN, click on the settings icon ⚙ in the *Internet/WAN* pane (Figure 2-19). Notice the *Vlan ID* field defaults to *0*. Click the checkbox by the field and enter a new VLAN ID within the range of 1–4094. The VLAN ID must be a unique number from any other VLAN. Avoid entering "12", which is commonly used by the LAN interface.

Table 2-6: WAN/LAN

Field Name	Description
Connect Type	Type of connection to the WAN: *Auto*, *Copper*, or *Fiber*. • Auto: Automatically matches an optical or electrical port based on the hardware connection • Copper: RJ-45 (electrical) port • Fiber: optical port
DNS Mode	Select DNS mode: • Auto: Selects DNS automatically. The DNS's current IP address displays if *Auto* is selected. • Manual: Set the DNS server manually if the IP address is a static one. The next DNS IP address must also be set if *Manual* is selected.
DNS Address 1	This parameter, which is DNS IP address 1, displays if DNS mode is set to *Manual*.
DNS Address 2	This parameter, which is DNS IP address 2, displays if DNS mode is set to *Manual*.
Link Speed Negotiated	Select negotiated link speed supported: *Auto negotiation*, *100M* (Mb/s), and *1000M*.
Allow management access over WAN	Enable or disable the LMT connection through the WAN port.
Enabled	Indicates if the interface is enabled or not. The eNB supports the configuration of four IP addresses at most.
Connect Via	Options for the interface protocol used by the WAN interface: • DHCP • Static IP NOTE: See detailed descriptions of each connection type in the section introduction above. The DHCP protocol is recommended. The displayed fields depend on which protocol is selected.
Current IP	The WAN interface IP address. The IP address is acquired automatically if "connect via" protocol type selected is *DHCP*.
Option60	This parameter displays if "connect via" protocol type selected is *DHCP*.
Subnet Mask	This parameter displays if "connect via" protocol type selected is *Static IP*. This is the IP address' subnet mask address.
Gateway	This parameter displays if "connect via" protocol type selected is *Static IP*. Used to set the default gateway's IP address.
Vlan ID	Used when the operator needs to transmit multi-types of data through separate channels via IP addresses for the WAN interface through VLAN. The VLAN IDs should be unique numbers not identical to any other VLAN. The range is 1 to 4094. Avoid using "12", which is commonly used by the LAN interface.

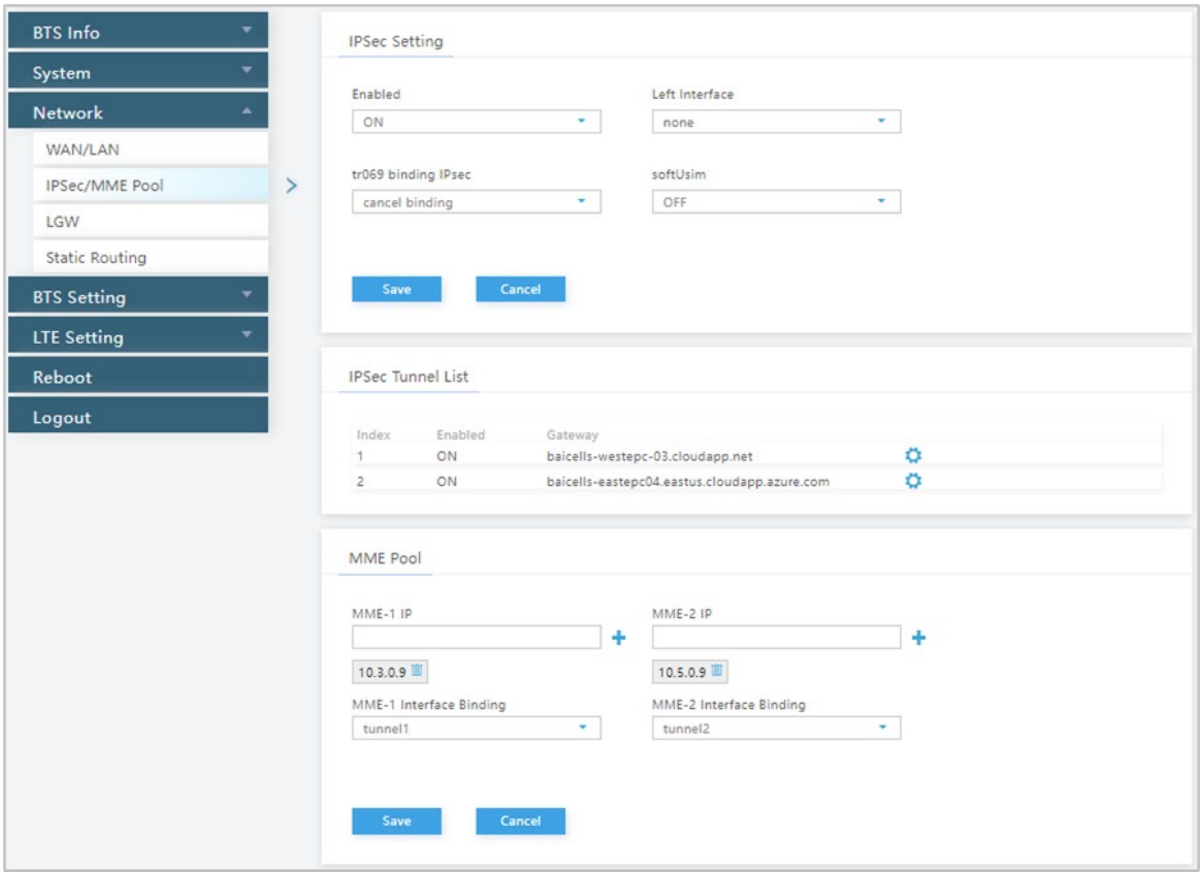
2.6.2 IPSec/MME Pool

NOTE 1: The *Network > IPSec/MME Pool* sub-menu is not shown for eNBs operating in HaloB mode.

NOTE 2: The MME IP addresses are **10.3.0.9** and **10.5.0.9** when using PLMN **314030** connecting to the Baicells CloudCore.

A Security Gateway (SeGW) in the network provides security protocol in the network layer to ensure message transmission safety. The *Network > IPSec/MME Pool* sub-menu (Figure 2-20) is used to enable the IP Security (IPSec) function and establish the safe Virtual Private Network (VPN) tunnel between the eNB and the SGW.

Figure 2-20: IPSec/MME Pool



2.6.2.1 IPSec Setting

The IPSec interface is used to route the control plane information between the eNB and the EPC, and is configured using the *IPSec Setting* pane of the *Network > IPSec/MME Pool* sub-menu (Figure 2-21). Notice that by default, the *Enabled* field in the *IPSec Setting* pane is *OFF*.

When this field is set to *ON*, the *tr069 binding IPsec* and *softUsim* fields display. The fields in the *IPSec Setting* pane are described in Table 2-7.

Figure 2-21: IPSec Setting

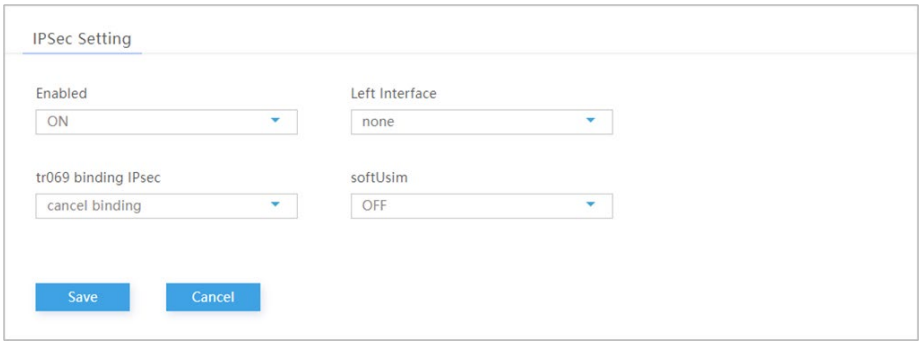


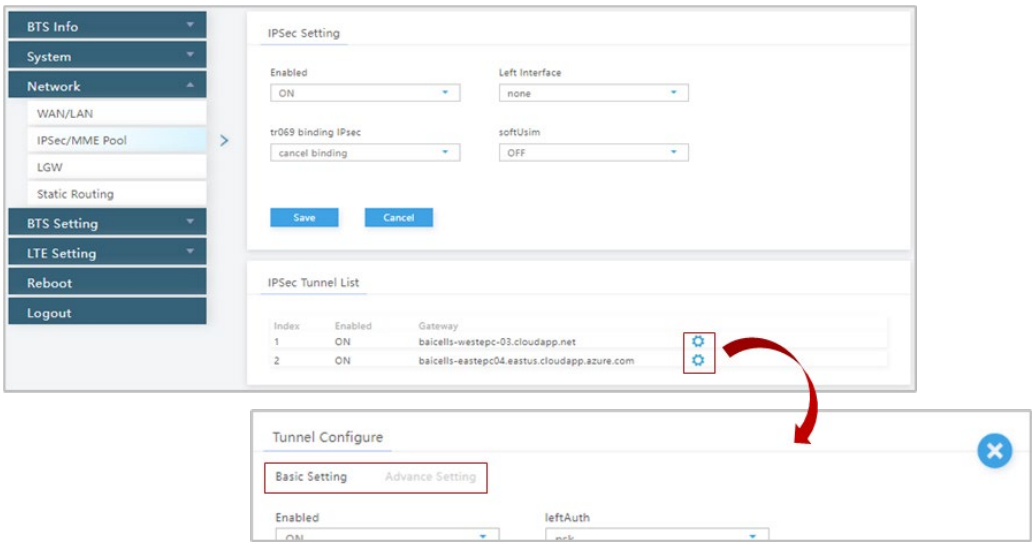
Table 2-7: IPSec Setting Fields

Field Name	Description
Enabled	Used to enable (*ON*) or disable (*OFF*) the IPSec function.
Left Interface	Binding interface on the eNB side. Default is *none*.
tr069 binding IPsec	Used to bind the TR-069 and the IPSec. Options are: • Cancel binding • ipsec 1 • ipsec 2 NOTE: This field displays when the IPSec function is enabled.
softUsim	Used to enable or disable the soft Universal Subscriber Identity Module (USIM) function. The softUsim parameter can be enabled (*ON*) when the IPSec authentication is configured to "eap-aka" in the *IPSec Tunnel List* pane (*section 2.6.2.2*). If the *softUsim* parameter is disabled, the hard USIM option is used. The *softUsim* parameter is disabled (*OFF*) by default. NOTE: This field displays when the IPSec function is enabled.
IMSI	Used to assign the IMSI. The range is 1 to 1024 digits. NOTE: This field displays when parameter *softUsim* is *ON*.
key	Used to assign the IMSI's key. The range is 1 to 1024 digits. NOTE: This field displays when parameter *softUsim* is *ON*.
opc	Used to assign the operator's code. The range is 1 to 1024 digits. NOTE: This field displays when the parameter *softUsim* is *ON*.

2.6.2.2 IPSec Tunnel List

In the *IPSec Tunnel List* pane of the *Network > IPSec/MME Pool* sub-menu, you can define up to two sets of data per IPSec tunnel. Tunnel 1 and Tunnel 2 display information about the tunnel gateway and status. The *Tunnel Configure* pane is used to configure the tunnel fields. You can open the *Tunnel Configure* pane by using the settings icon in the *IPSec Tunnel List* pane (Figure 2-22). Notice the two tabs in the *Tunnel Configure* pane: *Basic Setting* and *Advance Setting*. The *Basic Setting* tab fields display by default. The *Basic Setting* tab is described in *section 2.6.2.2.1*. The *Advance Setting* tab is described in *section 2.6.2.2.2*.

Figure 2-22: IPSec Tunnel List



2.6.2.2.1 Tunnel Configure - Basic Setting Tab

The *Basic Setting* tab in the *Tunnel Configure* pane is shown in Figure 2-23 and described in Table 2-8.

Figure 2-23: Tunnel Configure - Basic Setting Tab

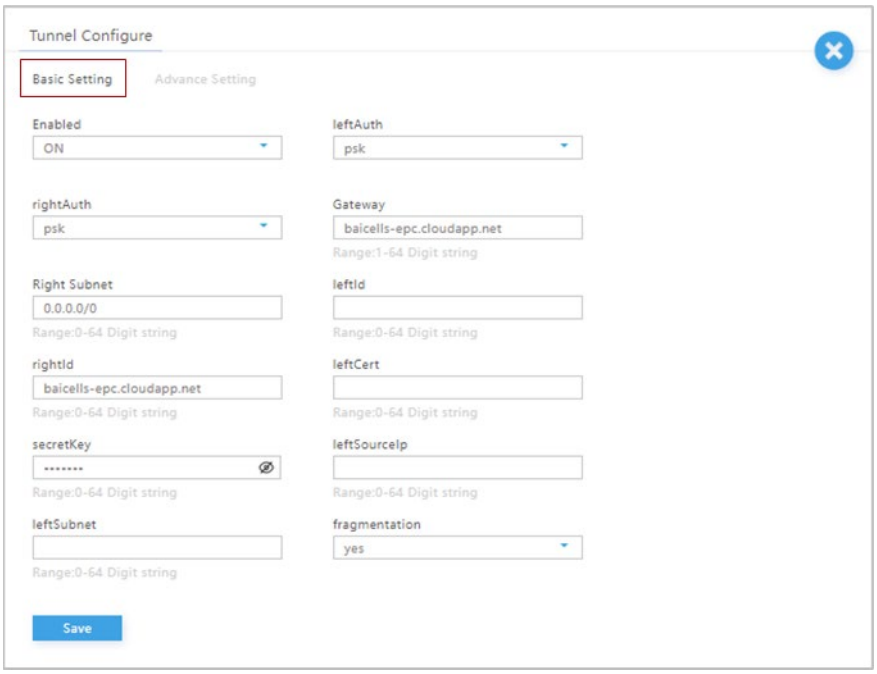


Table 2-8: Tunnel Configure > Basic Setting Tab Fields

Field Name	Description
Enabled	Used to enable (*ON*) or disable (*OFF*) the IPSec Tunnel. The default is *ON*.
leftAuth	**Caution: Change not recommended!** Authentication method of the IPSec server. Must be consistent with the security gateway side. Options are: • (psk) (default) • pubkey • eap-aka
rightAuth	**Caution: Change not recommended!** Peer authentication method of the IPSec server. Must be consistent with the security gateway side. Options are: • (psk) (default) • pubkey • eap-aka
Gateway	Enter the IPSec security gateway IP address. The range is 1–64 digit string. Make sure the IP address entered here matches the actual IP address on the security gateway side. When using the Baicells CloudCore, enter **baicells-epc.cloudapp.net** (tunnel1) and **baicells-east-epc.eastus.cloudapp.azure.com** (tunnel2).
Right Subnet	IP address of the remote subnet, which must be consistent with the security gateway side. The range is 0–64 digit string. Messages within this address range are packed as a tunnel.
LeftId	Identification of this client end (1–64 digit string). It must be consistent with the security gateway side. If there is no security gateway left identifier, leave this field empty.
RightId	Identification of the server end (1–64 digit string). It must be consistent with the security gateway side. If there is no security gateway right identifier, leave this field empty.
leftCert	Certificate name. This parameter needs to be defined if *leftAuth* parameter is set to *pubkey*. The range is 1–64 digit string.
secretKey	The private key file name. The range is 1–64 digit string. The default is *clientKey.bin*. When authentication is *psk*, the value is the password used for authentication (*leftAuth* and *rightAuth*).
leftSourceIp	Virtual address allocation assigned by the system. The range is 1–64 digit string. If absent, use the local IP address.

Field Name	Description
leftSubnet	The local subnet IP address. The range is 1–64 digit string.
fragmentation	The fragmentation type. Options are: • yes • accept • force • no

2.6.2.2.2 Tunnel Configure - Advance Setting Tab

Caution: Using the default values for the *Advance Setting* tab fields is highly recommended. Improper changes may lead to system exceptions.

The configuration options in the *Advance Setting* tab of the *Tunnel Configure* pane become particularly important to network operations as areas become denser with users. Please refer to Figure 2-24 and Table 2-9.

Figure 2-24: Tunnel Configure - Advance Setting Tab

[Recommend leaving at default values]

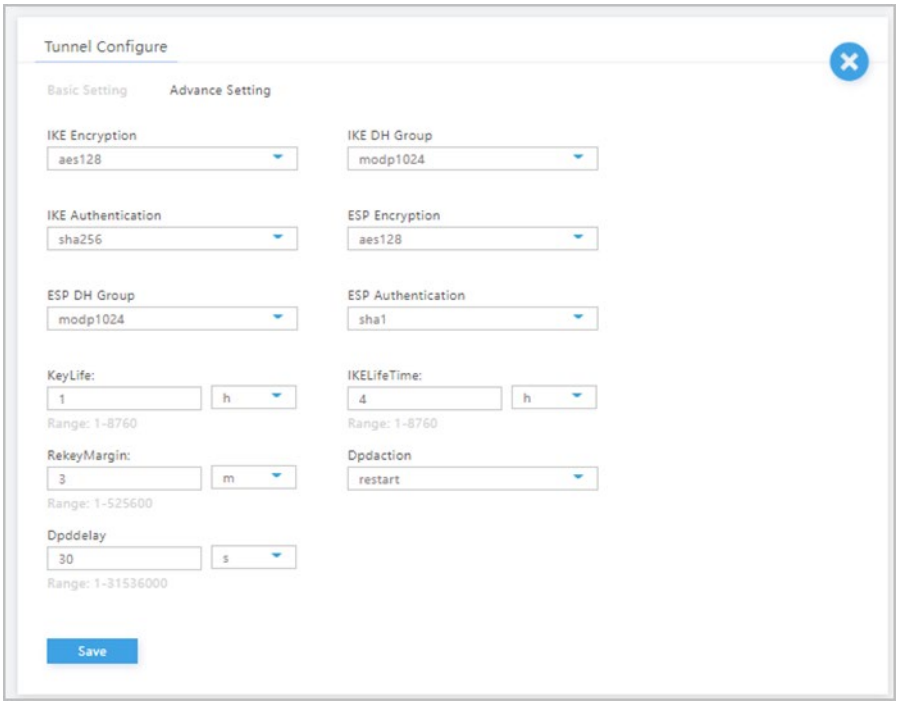


Table 2-9: Tunnel Configure > Advance Setting Tab Fields

[Recommend leaving at default values]

Field Name	Description
IKE Encryption	IKE encryption method. IKE is a protocol used to ensure security for VPN negotiation and remote host or network access. Options are: • aes128 (default) • aes256 • 3des • des
IKE DH Group	IKE Diffie-Hellman (DF) key computation, or exponential key agreement, to be used between two entities. Options are: • modp768 • modp1024 (default) • modp1536 • modp2048 • modp4096
IKE Authentication	IKE authentication algorithm to be used: • sha1 • sha1_160 • sha256_96 • sha256 (default)
ESP Encryption	Encapsulating Security Payload (ESP) – a member of the IPsec protocol suite that provides origin authenticity, integrity, and confidentiality protection of packets. Options: • aes128 (default) • aes256 • 3des • des
ESP DH Group	ESP DF key computation, or exponential key agreement, to be used between two entities. Options are: • modp768 • modp1024 (default) • modp1536 • modp2048 • modp4096
ESP Authentication	ESP authentication algorithm. Several options exist, but the algorithm to be used is *sha1*.
KeyLife	IPsec Security Association (SA) renegotiation time. Format: s (seconds), m (minutes), h (hours), or d (days). The range is 1–8760.
IKELifeTime	IKE SA renegotiation time. Format: s (seconds), m (minutes), h (hours), or d (days). The range is 1–8760.
RekeyMargin	Renegotiation time before the expiry of IKELifeTime (negotiate the IKE security association time before the expiry of IKELifeTime). Format: s (seconds), m (minutes), h (hours), or d (days). The range is 1–525600.

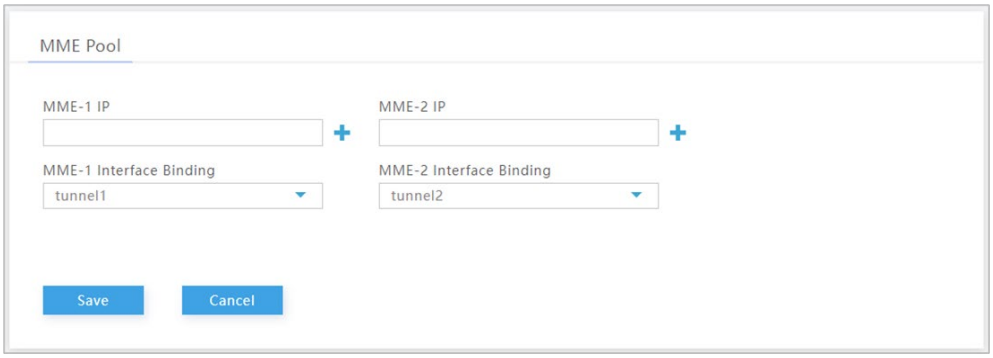
Field Name	Description
Dpdaction	Determines what action to take when a gateway exception occurs based on Dead Peer Detection (DPD) protocol: • none • clear • hold • restart (default)
Dpddelay	Time interval for sending the DPD detection message. Format: s (seconds), m (minutes), h (hours), or d (days). The range is 1–31536000.

2.6.2.3 MME Pool

In a typical network setup using the Baicells CloudCore, the security tunnel is between the eNB and the MME in the core network. The *MME Pool* pane of the *Network > IPSec/MME Pool* sub-menu is used to bind an IPSec tunnel with an MME IP address.

The Baicells CloudCore uses two MMEs: MME-1 and MME-2. MME-1 uses IP address **10.3.0.9** and MME-2 uses IP address **10.5.0.9**. Use the configuration fields for MME-1/tunnel1 and MME-2/tunnel2 to bind the interfaces (Figure 2-25).

Figure 2-25: MME Pool



2.6.3 LGW

Reference: *Set LGW Mode on eNB*

The Baicells eNodeB (eNB) splits the data plane and the control plane, so there are two IP addresses per CPE. The data plane is sent out the Local Gateway (LGW), while the control plane is routed through an IPSec tunnel to the Baicells CloudCore EPC.

Most manufacturers do not split the two planes and all traffic is sent through a hardware EPC. You have that option with Baicells as well, but anyone using the Baicells CloudCore EPC uses LGW.

Using the eNB GUI, follow the steps below to configure LGW.

1. Go to *Network > LGW*.
2. Verify that LGW is enabled.

3. Select one of three LGW modes (Figure 2-26, Figure 2-27, and Figure 2-28):

   - **NAT** - Network Address Translation - The IP address is kept local between the eNB and CPE. The eNB modifies the network address in the IP packet headers. To reach user equipment remotely, enter: **https://<eNB IP address><5+last 4 digits of CPE IMSI>**

     Leave the CPE Web GUI https port as **433**; do not change the port number. IP binding uses address range **10.10.0.1** to **10.10.0.254**.

   - **Router** - If you enable Static Address, configure the static address range by entering the first and last IP addresses; then, configure the IMSI to IP Binding (IMSI and IP address). The IMSI should be 15 digits. The LGW (external router) assigns an IP address when a CPE attaches. IP binding uses address range **10.10.0.1** to **10.10.0.254**.

   - **Bridge** - Layer 2 creates a virtual interface for each CPE that attaches using a DHCP request to create a 1:1 mapping between the CPE IP address (from the EPC) and the LGW IP address. A CPE's MAC address is generated from its IMSI: Convert the last 12 digits to hex, and then prefix it with "8A". For example, if the IMSI = 117040000002918, the MAC address would be 8A:95:02:F9:B6:6.

4. Enter the required fields. The only option currently available for the *LGW Interface Binding* is *fm1-mac1*. You can then enter the LGW IP Pool address and netmask. The IP binding range is **10.10.0.1** to **10.10.0.254**.

5. If you change the LGW mode, you must perform a reboot of the eNB for the changes to take effect.

Caution: The reboot action temporarily disrupts eNB service.

Figure 2-26: LGW Setting (NAT Mode)

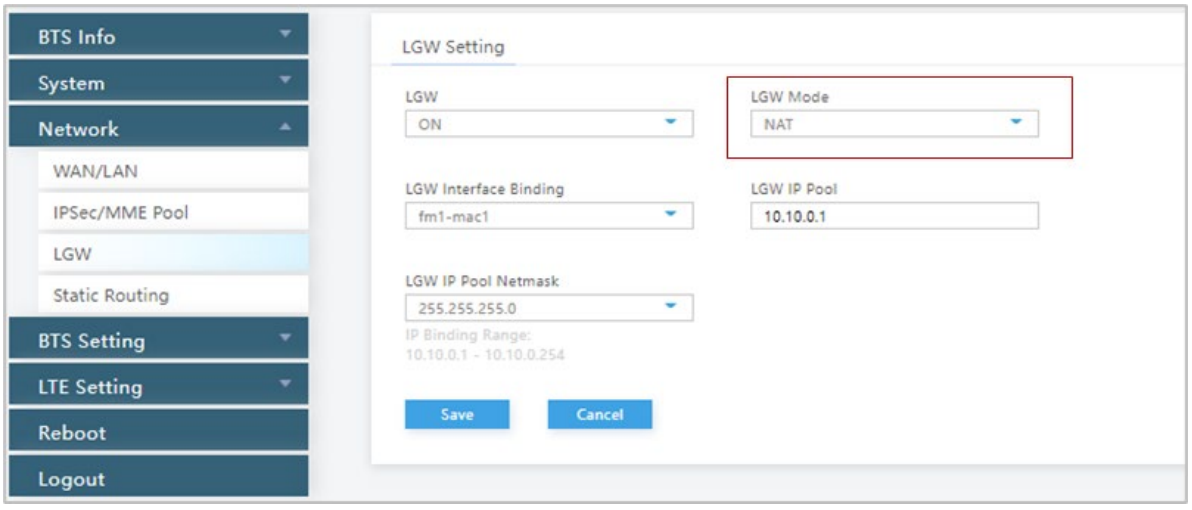


Figure 2-27: LGW Setting (Router Mode)

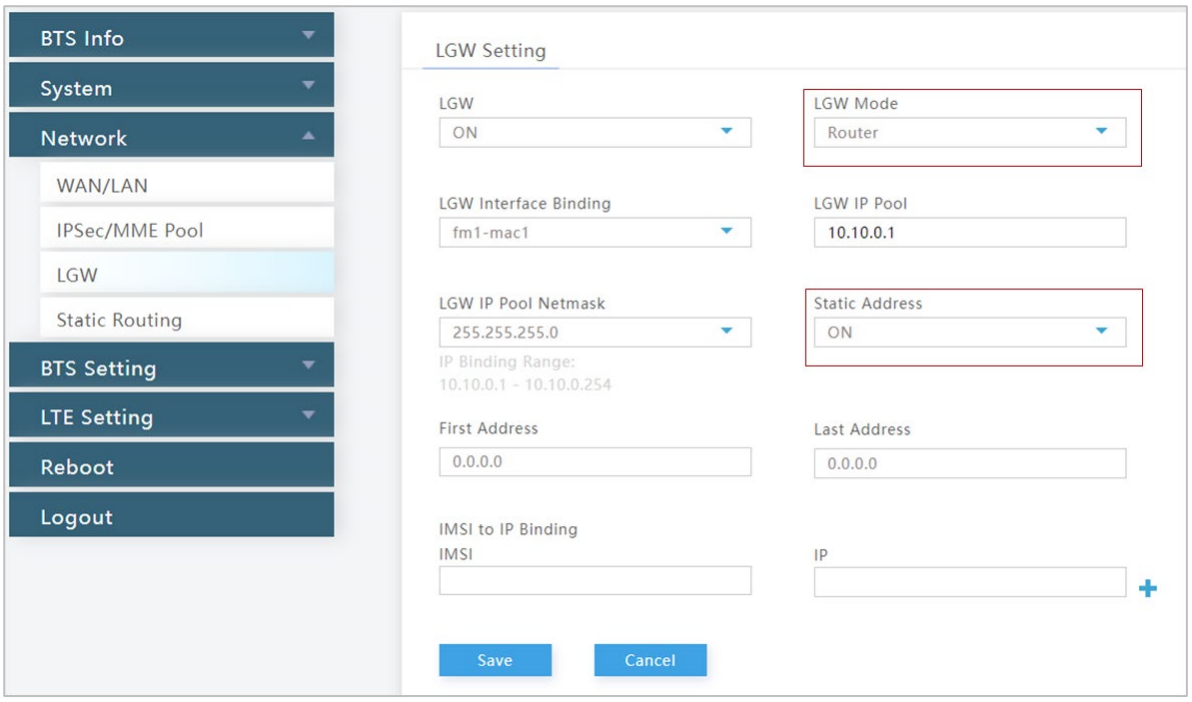
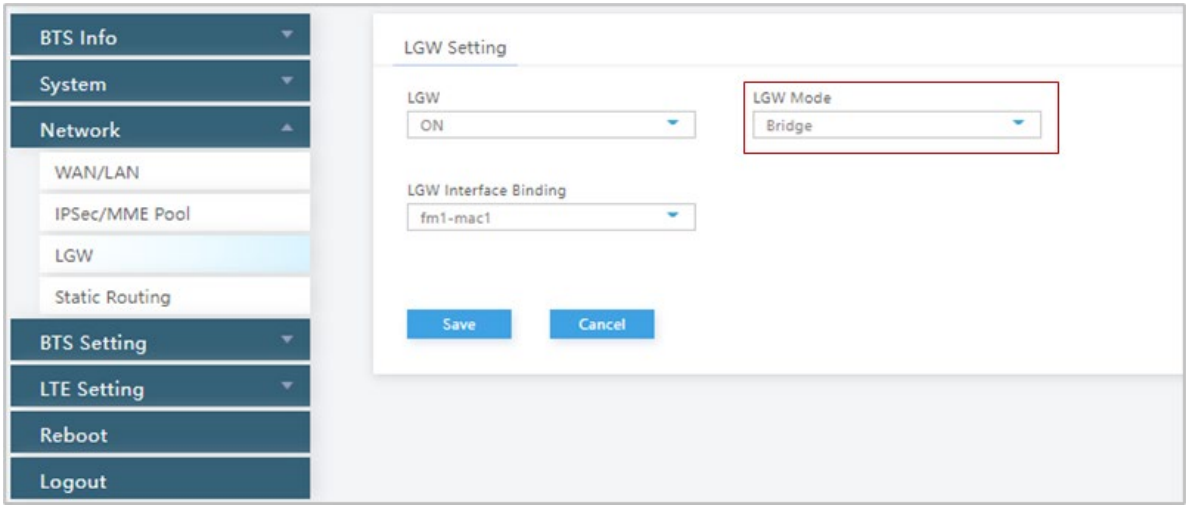


Figure 2-28: LGW Setting (Bridge Mode)



2.6.4 Static Routing

Use the *Network > Static Routing* sub-menu to add Static IP routing addresses and monitor their status (Figure 2-29). Existing routes display in the *Validated Route List* pane, showing the destination IP address, gateway, netmask or genmask (for general destination netmask), and other data. The system supports up to a maximum of four static routes, which are shown in the *Static Routing Setting* pane.

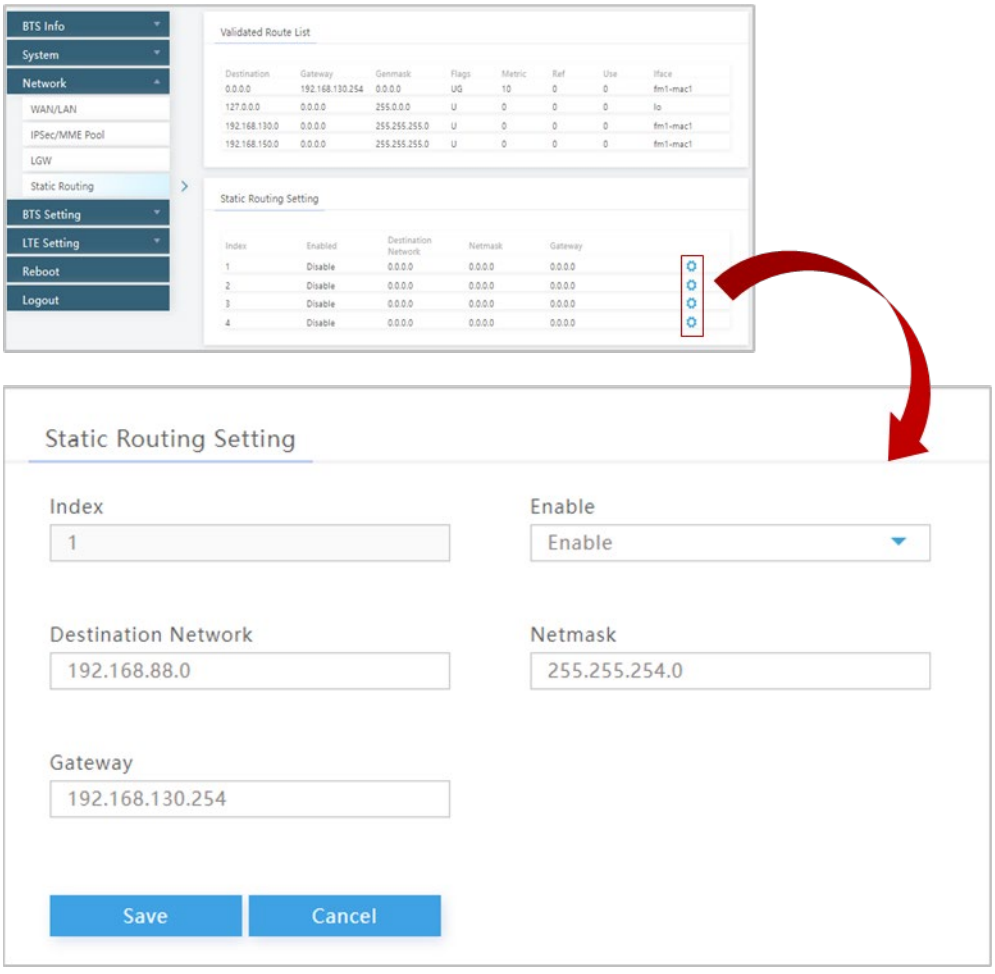
To add a new static routing address to the list or edit an existing one:

1. Click on the settings icon ⚙ in the *Static Routing Setting* pane.
2. Enter the IP addresses for the destination network, netmask, and gateway.

NOTE: The target IP address must be reachable from the original WAN interface IP address or VLAN source port.

3. Enable/disable the address as required.
4. Click on *Save*.

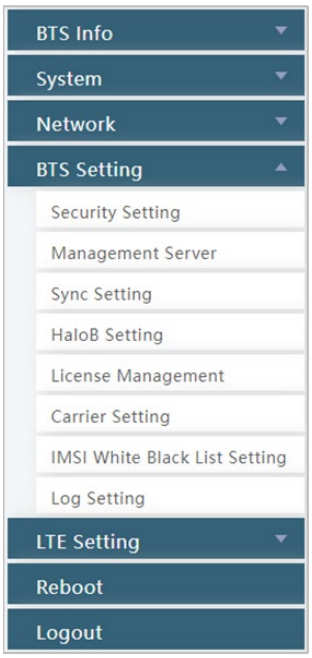
Figure 2-29: Static Routing



2.7 BTS Setting

The Base Transceiver Station (BTS) settings (Figure 2-30) relate to eNB security, management, synchronization with other network elements, HaloB function, managing licenses, configuring the carrier setting, creating white and black lists, and log setting.

Figure 2-30: BTS Setting Menu



2.7.1 Security Setting

Caution: Do not modify these security settings; keep the default values.

The *BTS Setting > Security Setting* sub-menu pertains to the LTE encryption algorithms that are used by the eNB (Figure 2-31). The selections depend on the LTE core network setup. These settings apply to both the primary (Cell1) and secondary (Cell2) cell when the eNB is set up as a two-carrier eNB. Table 2-10 describes the fields in the *BTS Setting > Security Setting* sub-menu.

Figure 2-31: Security Setting

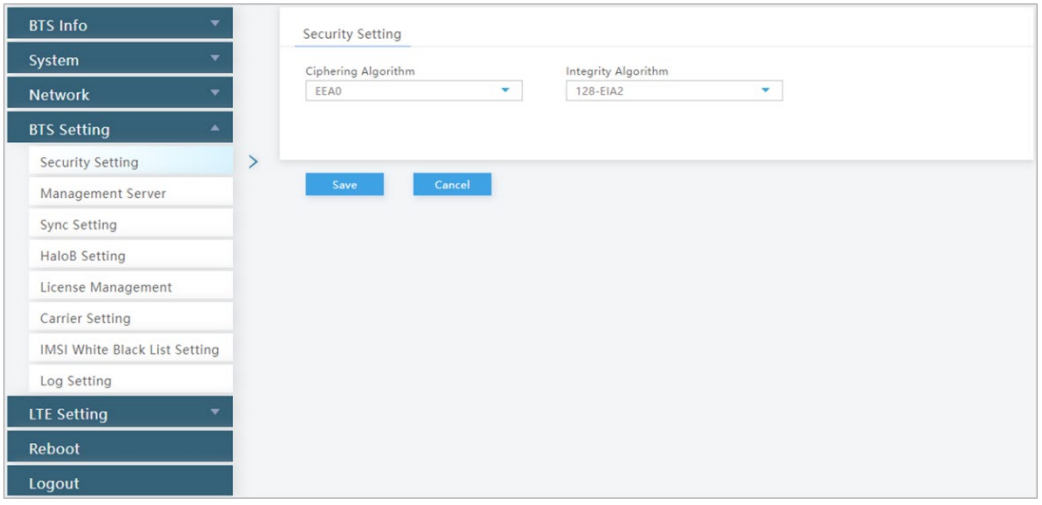


Table 2-10: Security Settings - For Information Only

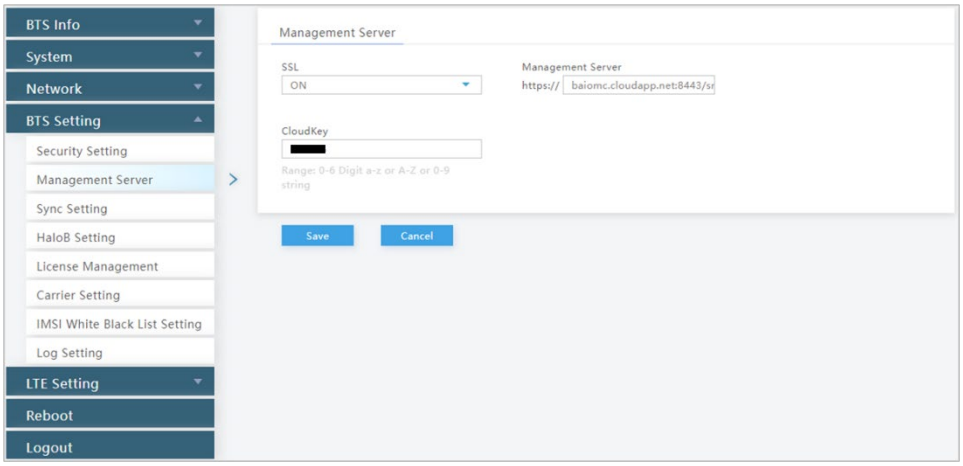
Field Name	Description
Ciphering Algorithm	Encryption algorithm options: • 128-EEA1 • 128-EEA2 • EEA0 (default)
Integrity Algorithm	Integrity protection algorithm options: • 128-EIA1 • 128-EIA2 (default)

2.7.2 Management Server

The *BTS Setting* > *Management Server* sub-menu is used to define the Network Management Service (NMS). An operator has the option to use the Baicells CloudCore OMC, a Local OMC, or their own management server (Figure 2-32). Follow the steps below to configure the management server.

1. Optional: Enable a Secure Socket Layer (SSL) connection for enhanced security.
2. Enter the https:// address for your management server. The *Management Server* field displays the default management server address and port number "8443" for the Baicells CloudCore OMC: **baiomc.cloudapp.net:8443/smallcell/AcsService**. If you are using Local OMC, another Element Management System (EMS), or NMS server, enter the URL for that device.
3. If you are using the Baicells CloudCore OMC for your NMS, enter your unique operator CloudKey ID that you received from Baicells. The CloudKey is used as part of the plug-and-play aspect of the Baicells network elements. When you configure your CloudKey number in the device GUI (eNB and CPE), the first time the device is powered on it is automatically associated to your OMC account.

Figure 2-32: Management Server



2.7.3 Sync Setting

The LTE technology standards specify timing and synchronization requirements between adjacent eNBs. Synchronized transmissions help eNBs avoid interfering with one another, optimize bandwidth usage, and enhance network capacity. The Global Positioning System (GPS) synchronized transmission type is currently

available, and the synchronized transmissions can be enabled for sync modes to operate simultaneously or independently.

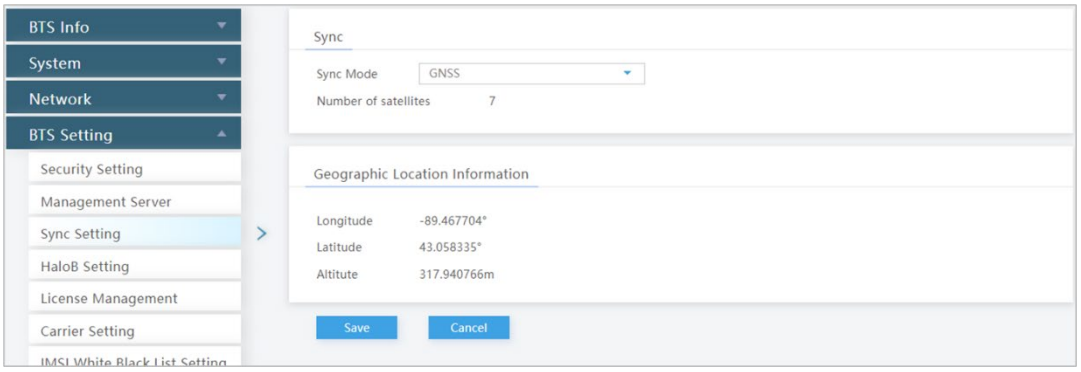
In the *BTS Setting > Sync Setting* sub-menu (Figure 2-33), use the drop-down menu in the *Sync Mode* field of the *Sync* pane to select the timing technology. The modes are:

- Global Navigational Satellite System (GNSS): GPS synchronization.
- FREE_RUNNING: uses a crystal oscillator for synchronization.
- BEIDOU: a type of synchronization that is used in international global markets.
- GPS_BEIDOU: a type of synchronization that combines GPS and BEIDOU.

NOTE: The current number of satellites the GPS is tracking, as well as their signal strength, displays when sync mode *GNSS*, *BEIDOU*, or *GPS_BEIDOU* is selected.

When you click on *Save* to retain the settings, a pop-up message displays prompting you to reboot the eNB for the new settings to be applied. Click on *OK*.

Figure 2-33: GPS Sync Setting



2.7.4 HaloB Setting

Reference: *HaloB Solution User Guide*

The *BTS Setting > HaloB Setting* sub-menu (Figure 2-34) is used by operators who have a HaloB license for the eNB. An eNB operating in HaloB mode provides “lite” core functions so it can continue serving subscribers even when it has no connection to the LTE EPC. There are two HaloB operating modes: Centralized and Standalone. Table 2-11 describes the fields in the *BTS Setting > HaloB Setting* sub-menu.

The HaloB license key comes in Centralized Mode by default and displays in the *HaloB Mode* field drop-down menu. In Centralized Mode, the eNB needs to connect to the CloudCore BOSS module, which acts as an agent to manage Subscriber Identity Module (SIM) card data.

To include Standalone Mode, you must send a special request to the Baicells support team. Once you are authorized to use Standalone Mode and purchase that license, *Single Mode* displays in the *HaloB Mode* field drop-down menu. In Standalone Mode, the client can maintain the SIM card data and Access Point Name (APN) information locally.

Refer to the *HaloB Solution User Guide* for detailed information regarding the configuration requirements for the HaloB feature.

Figure 2-34: HaloB Setting

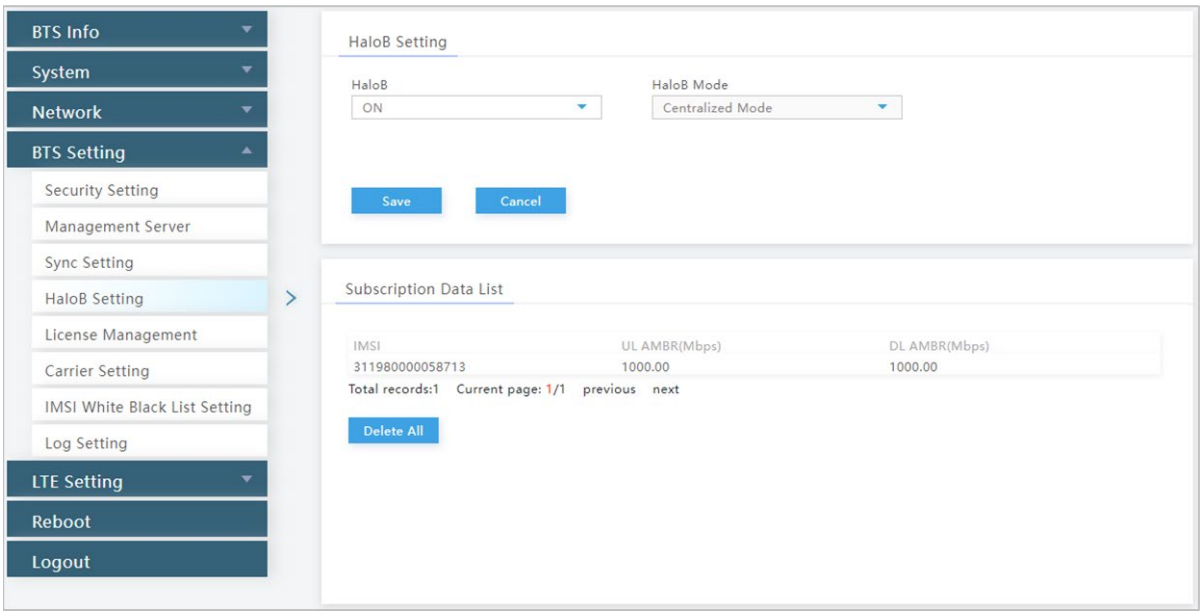


Table 2-11: HaloB Setting Fields

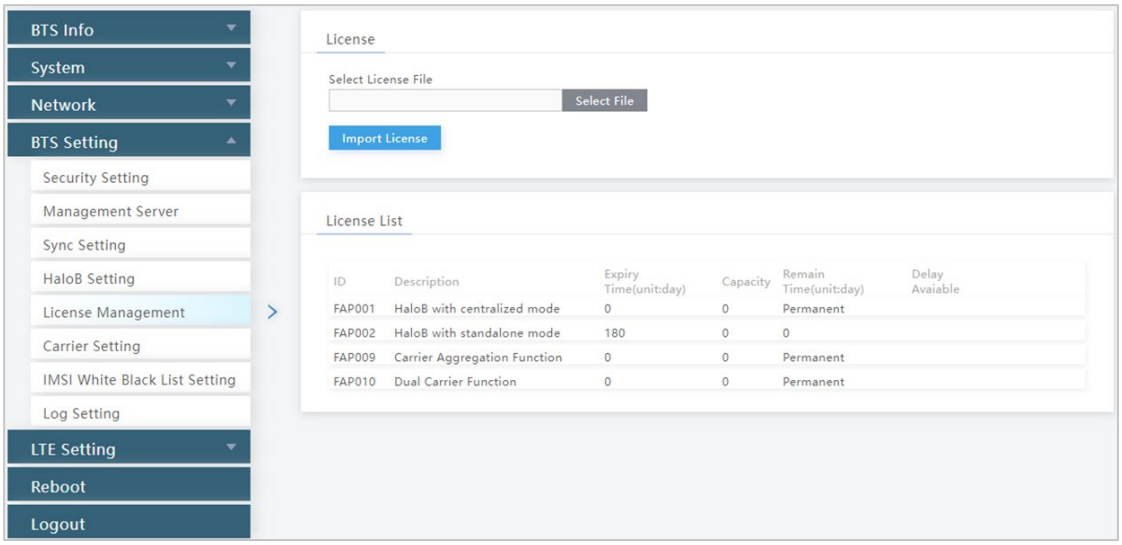
Field Name	Description
HaloB	Used to enable (*ON*) or disable (*OFF*) the HaloB function.
HaloB Mode	Used to select the operating mode for the HaloB function (Centralized Mode or Standalone Mode).
Subscription Data List	
IMSI	The IMSI number. An IMSI is used to identify the user of a cellular network and is a unique identification associated with all cellular networks.
UL AMBR(Mbps)	The uplink Aggregate Maximum Bit Rate (AMBR), which is the maximum possible bit rate configured by the LTE operator for a particular LTE user.
DL AMBR(Mbps)	The downlink AMBR.

2.7.5 License Management

The *BTS Setting > License Management* sub-menu may be used to import license files for optional features such as HaloB or regulatory certificates of authorization to operate (Figure 2-35). When imported, the files are stored in the eNB memory and shown in the *License List* pane.

NOTE: You have to manually refresh the page after you upload a license before it displays in the *License List* pane.

Figure 2-35: License Management



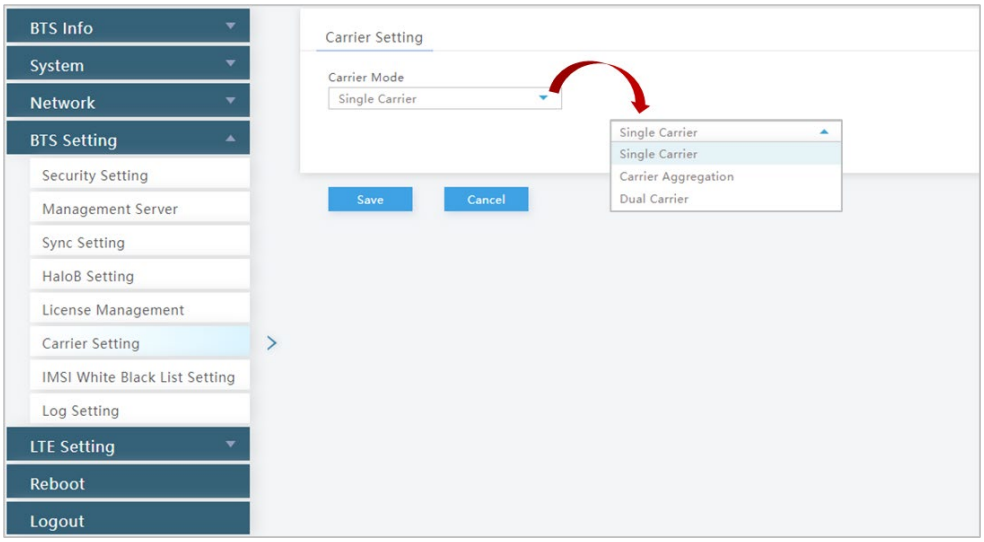
2.7.6 Carrier Setting

Reference: *Carrier Aggregation & Dual Carrier/Split Mode Configuration Guide*

The *BTS Setting > Carrier Setting* sub-menu (Figure 2-36) is used to set the eNB to run as either a single carrier, two combined carriers using Carrier Aggregation (CA), or two separate carriers using Dual Carrier (DC)/split mode. In single carrier mode only Cell 1 operates, and it uses only two RF ports instead of four. Operators may need to use this mode if they have limited spectrum or are planning to change to DC mode at a later time, for example when more capacity is needed for the coverage area.

Whenever you change the carrier setting, you must perform a reboot of the eNB for the change to take effect.

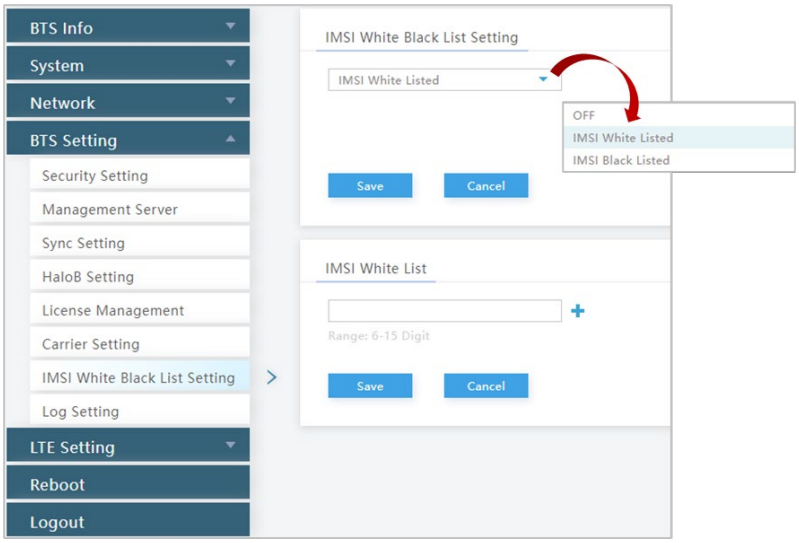
Figure 2-36: Carrier Setting



2.7.7 IMSI White and Black List Setting

The *BTS Setting > IMSI White Black List Setting* sub-menu (Figure 2-37) is used to allow or deny access to the eNB using the IMSI. The IMSI identifies the user of a cellular network and is a unique identification associated with all cellular networks. Access to the eNB is allowed to users on the white list and is denied to users on the black list. The example in Figure 2-37 shows the *IMSI White List* pane that displays when it is selected from the drop-down menu in the *IMSI White Black List Setting* pane. Once you enter an IMSI number in the range of six to 15 digits and click the **+** (Add) icon, the IMSI is listed. Click *Save* to save the added IMSI. You can delete an IMSI using the recycle bin icon. This is the same procedure you use to add and delete an IMSI in the *IMSI Black List* pane when you select that option from the drop-down menu in the *IMSI White Black List Setting* pane.

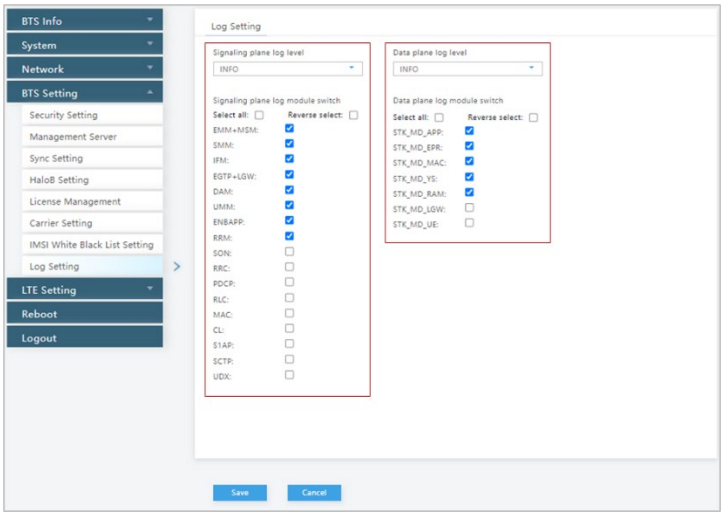
Figure 2-37: IMSI White Black List Setting



2.7.8 Log Setting

The *BTS Setting > Log Setting* sub-menu (Figure 2-38) is used to select the log level setting for both the signaling plane and the data plane. The log module switch for each plane is shown in Figure 2-38.

Figure 2-38: Log Setting

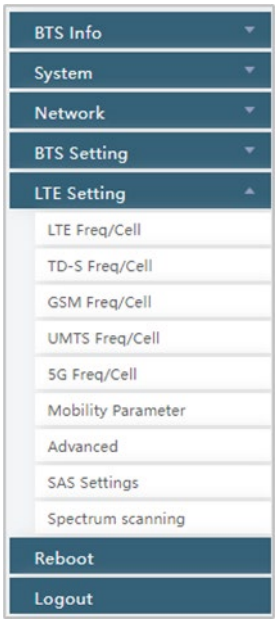


2.8 LTE Setting

The *LTE Setting* menu (Figure 2-39) contains several sub-menus related to mobility as well as other radio-related settings. Many LTE parameters are important for efficient wireless network operation. It's a good idea to review all of the information in this section to understand how the configuration settings relate.

If you change these parameters, perform a reboot of the eNB for the new configuration to take effect. A case study for LTE-to-LTE handoffs is provided in *section 2.9*.

Figure 2-39: LTE Setting Menu



NOTE 1: HaloB-enabled eNBs operate as standalone entities and do not support mobility. So, the *LTE Setting* menu options change depending on configurations in the *BTS Setting > HaloB Setting* sub-menu (*section 2.7.4*).

NOTE 2: The terms handoff and handover are used interchangeably in LTE.

The first five sub-menus (*LTE Freq/Cell*, *TD-S Freq/Cell*, *GSM Freq/Cell*, *UMTS Freq/Cell*, and *5G Freq/Cell*) under the *LTE Setting* menu are used to configure the neighboring eNBs' frequencies and identify each eNB running on that frequency.

The *LTE Freq/Cell* configuration requirements are described in *section 2.8.1*. The *TD-S Freq/Cell* configuration requirements are described in *section 2.8.2*. The *GSM Freq/Cell* configuration requirements are described in *section 2.8.3*. The *UMTS Freq/Cell* configuration requirements are described in *section 2.8.4*. The *5G Freq/Cell* configuration requirements are described in *section 2.8.5*.

Important: Make sure the current and neighboring eNBs are synchronized to help the eNBs avoid interfering with one another (see *section 2.7.3*).

The *LTE Setting > Mobility Parameter* sub-menu is used to configure the current eNB's mobility parameters (*section 2.8.6*). The *LTE Setting > Advanced* sub-menu is used to examine the current eNB's advanced settings (*section 2.8.7*). The *LTE Setting > SAS Settings* sub-menu is used to enable SAS and select the SAS registration type (*section 2.8.8*).

When setting up mobility, you have to establish the neighboring eNBs operating in the same geographical area as is the eNB that you are configuring. This information is completed for each eNB so that the eNBs collectively work well with one another to handle mobile users and to balance the traffic load.

Depending on geographic region, there are five types of neighboring eNBs: other LTE eNBs; eNBs running another type of wireless technology called Time Division Synchronous Code Division Multiple Access (TD-SCMDA); those operating with the Global System for Mobile (GSM) communications technology; those operating with the Universal Mobile Telecommunications System (UMTS); and those operating with Fifth-Generation Wireless Systems (5G).

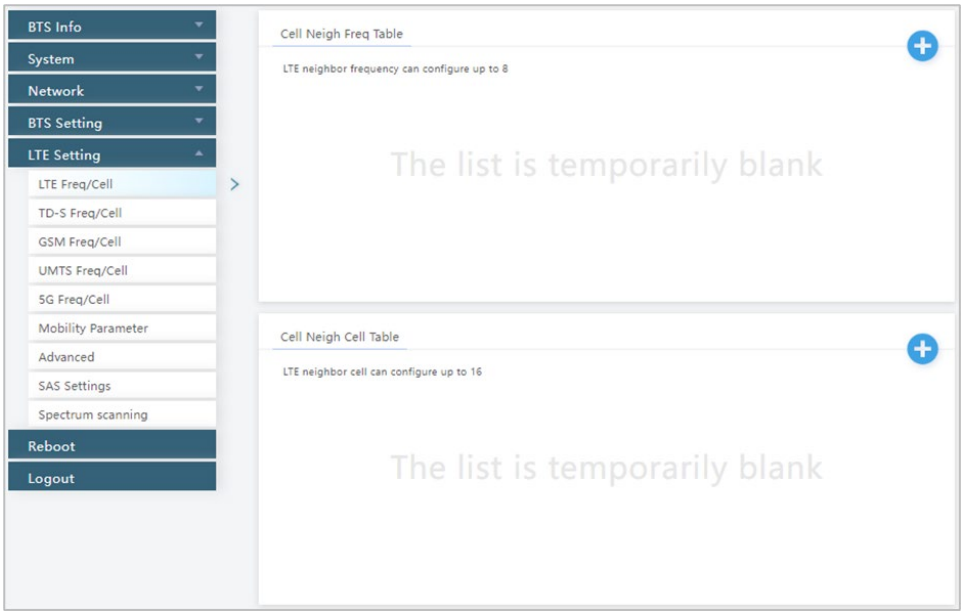
For each type of neighboring eNB, you first add the neighbor frequency settings via the *Cell Neigh Freq Table*, and then you add the cell information associated to the frequencies via the *Cell Neigh Cell Table*. You can configure the *Cell Neigh Cell Table* for both inter-frequency (between different frequencies) and intra-frequency (within the same frequency) neighboring eNBs. For inter-frequency cells, you must add the neighbor inter-frequency settings in the *Cell Neigh Frequency Table* before you try to add the neighbor inter-frequency cell (eNB) information. Conversely, if you need to delete a neighbor inter-frequency record, you must first delete the neighbor inter-frequency cells (eNBs) associated to it. For an intra-frequency neighbor cell, meaning a neighbor eNB operates on the same frequency as the eNB you are configuring, you do not need to configure the *Cell Neigh Freq Table* but you do need to configure the *Cell Neigh Cell Table*.

2.8.1 Configure LTE Neighbor Settings

Using the *LTE Setting > LTE Freq/Cell* sub-menu (Figure 2-40), you can configure parameters related to how adjacent eNBs operating with LTE technology work with the Baicells LTE eNB that you are configuring. You define for the Baicells eNB how to deal with any neighboring LTE eNBs. *Section 2.8.1.1* describes how to configure LTE neighbor frequency settings and *section 2.8.1.2* describes how to configure LTE neighbor cells associated to those frequencies.

NOTE: If the eNB is set to *Dual Carrier* using the *BTS Setting > Carrier Setting* sub-menu, then the *LTE Setting > LTE Freq/Cell* sub-menu GUI displays configuration tables (settings) for both Cell1 and Cell2. Figure 2-40 shows the GUI when the carrier mode is *Single Carrier*.

Figure 2-40: LTE Neighbor Settings (*LTE Setting > LTE Freq/Cell*)



2.8.1.1 Configure LTE Neighbor Frequency Settings

You can configure up to eight LTE neighbor frequency tables. To open the *Cell Neigh Freq Settings* window (Figure 2-41), click on the **+** (Add) icon in the *Cell Neigh Freq Table* pane of the *LTE Setting > LTE Freq/Cell* sub-menu. The parameters shown in the figure reflect the recommended settings for this operator example. The parameters are described in Table 2-12.

Figure 2-41: LTE Neighbor Frequency Settings

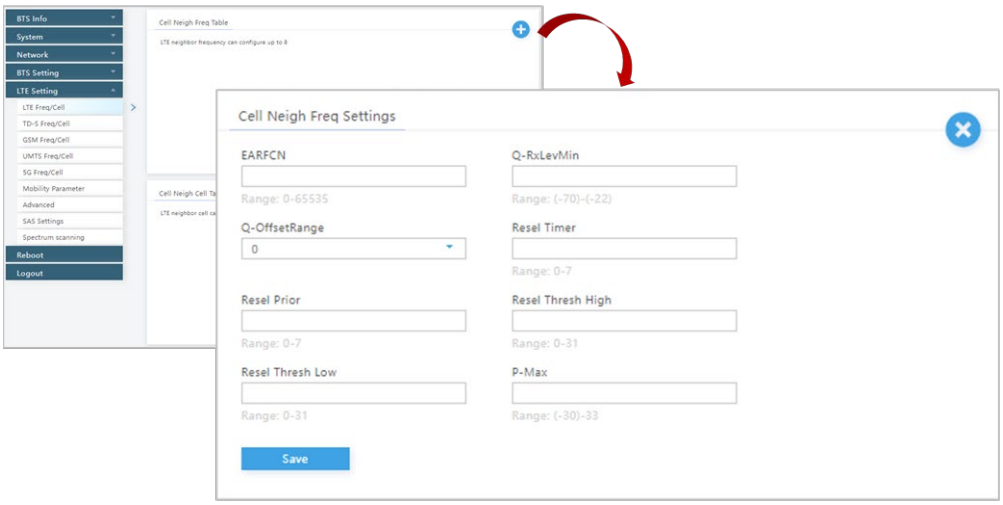


Table 2-12: LTE Neighbor Frequency Settings Fields

Field Name	Description
EARFCN	In short, this is the frequency point of the neighboring eNB's frequency. The range is 0–65535. EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number.
Q-RxLevMin	The minimum received signal level at which the CPE detects a neighboring eNB's signal. The range is -70 to -22 dBm. A typical value is -62, which equals -124 dBm.
Q-OffsetRange	Indicates the difference in signal level between the serving and neighboring eNBs, as determined by the received signal level at the CPE. If the received signal level is better from a neighboring eNB by at least this amount of difference in dB, the CPE reselects the other cell. The range is +24 to -24 dB. A typical value is 0 dB.
Resel Timer	Determines when the cell reselection timer expires. The range is 0–7 seconds. A typical value is 0 seconds.
Resel Prior	Priority of cell reselection to cells at this frequency. The range is 0–7. A typical value is 4.
Resel Thresh High	The cell reselection threshold for higher priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has a higher cell reselection priority than the serving cell). The range is 0–31 dB. A typical value is 18 dB.
Resel Thresh Low	The cell reselection threshold for lower priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has an absolute priority lower than the serving cell). The range is 0–31 dB. A typical value is 13 dB.
P-Max	The maximum transmit power that CPEs in this cell are allowed to use in the uplink. The range is -30 to 33 dBm. A typical value is 23 dBm.

2.8.1.2 Configure LTE Neighbor Cell Settings

You can configure up to 16 LTE neighbor cell tables. To open the *Cell Neigh Cell Settings* window (Figure 2-42), click on the **+** (Add) icon in the *Cell Neigh Cell Table* pane of the *LTE Setting > LTE Freq/Cell* sub-menu. The parameters shown in the figure reflect the recommended settings for this operator example. The parameters are described in Table 2-13.

Figure 2-42: LTE Neighbor Cell Settings

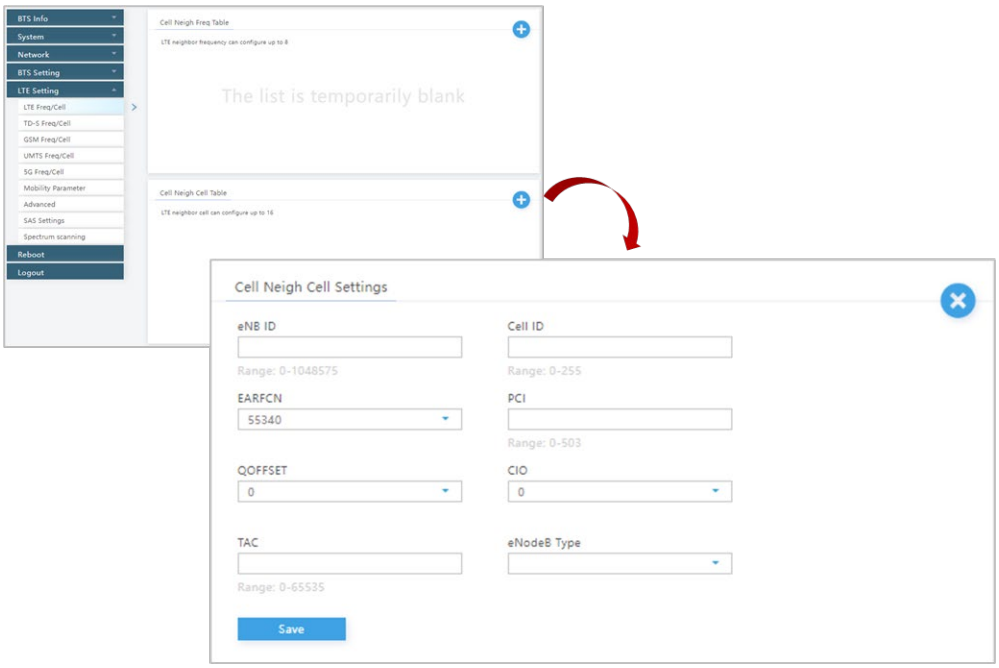


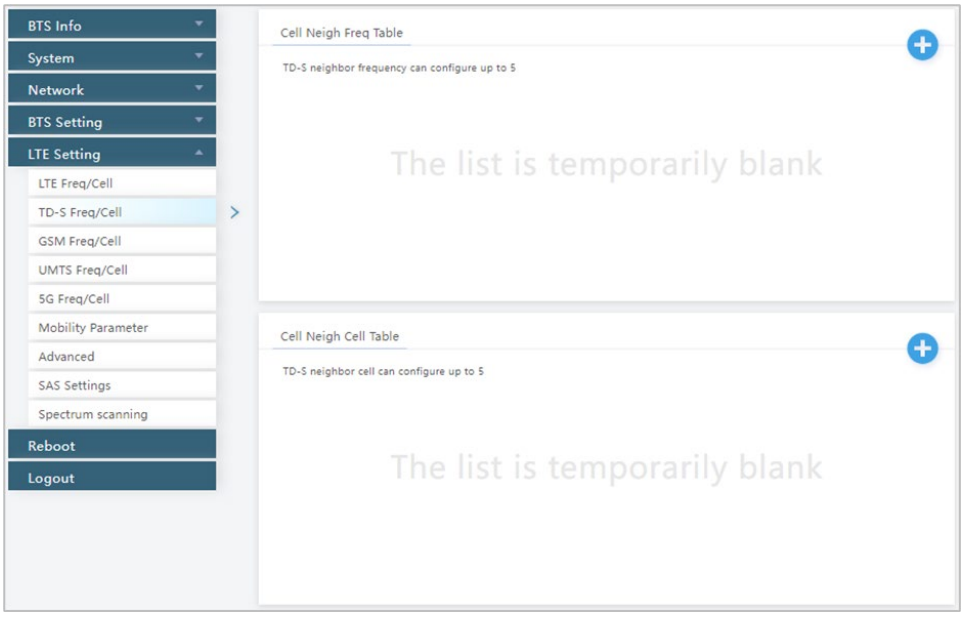
Table 2-13: LTE Neighbor Cell Settings Fields

Field Name	Description
eNB ID	A unique identification number for the eNB. The range is 0–1048575.
Cell ID	A unique identification number for the cell. The range is 0–255.
EARFCN	Frequency point of the neighbor cell. EARFCN stands for Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (E-UTRA) Absolute Radio Frequency Channel Number. The only option currently available is 56290.
PCI	PCI of the neighbor cell. The range is 0–503.
QOFFSET	Frequency offset of this neighbor cell. Indicates the difference in signal level between the serving and this neighboring eNB, as determined by the received signal level at the CPE. If the received signal level is better from this neighbor eNB by at least this amount of difference in dB, the CPE reselects this cell. The range is +24 to -24 dB. A typical value is 0 dB.
CIO	Cell Individual Offset (CIO) is this neighbor eNB's cell offset, which is one of the variables used to determine which eNB best serves a given CPE. The range is -24 to 24 dB. A typical value is 0 dB.
TAC	Tracking Area Code (TAC) of this neighbor cell. The range is 0–65535.
eNodeB Type	The eNB type (Macro or Home). • Macro: The eNB is covering a large cell area and the transmission power in on the higher end of the power range. • Home: The eNB's transmission power is much lower than Macro and covers a smaller area.

2.8.2 Configure TD-S Neighbor Settings

Using the *LTE Setting > TD-S Freq/Cell* sub-menu (Figure 2-43), you can configure parameters related to how adjacent eNBs operating with TD-SCDMA technology work with the Baicells LTE eNB that you are configuring. You define for the Baicells eNB how to deal with any neighboring TD-SCDMA eNBs. *Section 2.8.2.1* describes how to configure TD-S neighbor frequency settings and *section 2.8.2.2* describes how to configure TD-S neighbor cells associated with those frequencies.

Figure 2-43: TD-S Neighbor Settings (*LTE Setting > TD-S Freq/Cell*)



2.8.2.1 Configure TD-S Neighbor Frequency Settings

You can configure up to five frequency tables for TD-S eNBs. To open the *CELL Neigh Freq Settings* window (Figure 2-44), click on the **+** (Add) icon in the *CELL Neigh Freq Table* pane of the *LTE Setting > TD-S Freq/Cell* sub-menu. The parameters are described in Table 2-14.

NOTE: Even though some of the TD-S neighbor frequency setting field names are the same as in the LTE neighbor frequency setting field names, in some cases the ranges are different for TD-SCDMA. See Table 2-14.

Figure 2-44:TD-S Neighbor Frequency Settings

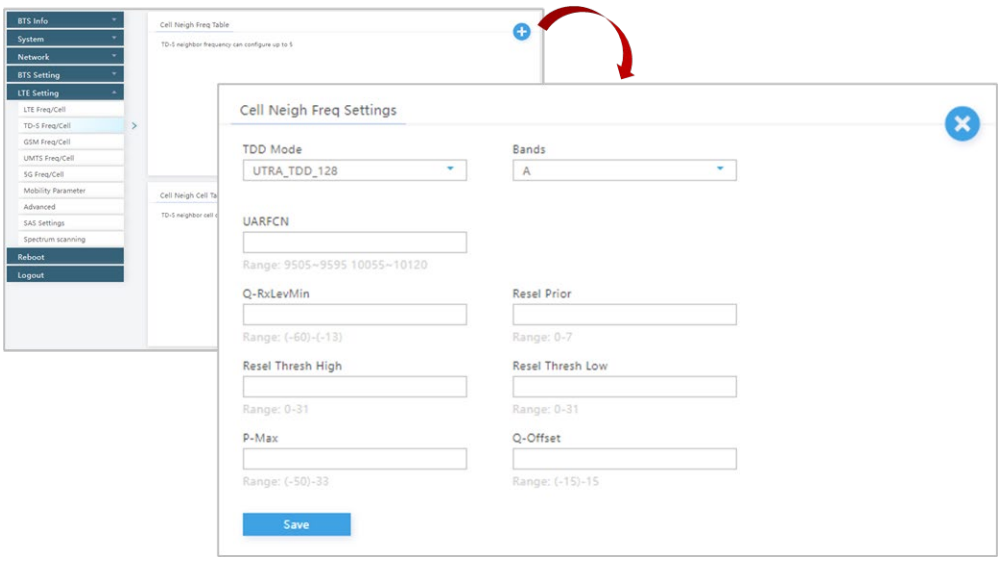


Table 2-14: TD-S Neighbor Frequency Settings Fields

Field Name	Description
TDD Mode	Select a chip rates (bps) to spread the signal. Options are: UTRA_TDD_128, UTRA_TDD_384, or UTRA_TDD_768.
Bands	Channels in which the TD-S neighbor eNB operates. Options are A, B, C, D, E, or F.
UARFCN	In short, this is the frequency point of the neighboring eNB's frequency. The range is 9505 to 9595 MHz, or 10055 to 10120 MHz. The acronym stands for Universal Mobile Telecommunications System (UMTS) Absolute Radio Frequency Channel Number.
Q-RxLevMin	Minimum received signal level at which a CPE detects a neighboring eNB's signal. The range is -60 to -13 dBm.
Resel Prior	Priority of cell reselection to cells at this frequency. The range is 0–7.
Resel Thresh High	The cell reselection threshold for a higher priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has a higher cell reselection priority than the serving cell). The range is 0–31.
Resel Thresh Low	The cell reselection threshold for a lower priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has an absolute priority lower than the serving cell). The range is 0–31.
P-Max	The maximum transmit power CPEs in this cell are allowed to use uplink. The range is -50 to 33 dB.
Q-Offset	Indicates the difference in signal level between the serving and neighboring eNBs, as determined by the received signal level at the CPE. If the received signal level is better from a neighboring eNB by at least this amount of difference in dB, the CPE reselects the other cell. The range is -15 to 15 dB.

2.8.2.2 Configure TD-S Neighbor Cell Settings

You can configure up to five cell tables for the TD-S eNBs. To open the *CELL Neigh Cell Settings* window (Figure 2-45), click on the **+** (Add) icon in the *CELL Neigh Cell Table* pane of the *LTE Setting > TD-S Freq/Cell* sub-menu. The parameters are described in Table 2-15.

Figure 2-45: TD-S Neighbor Cell Settings

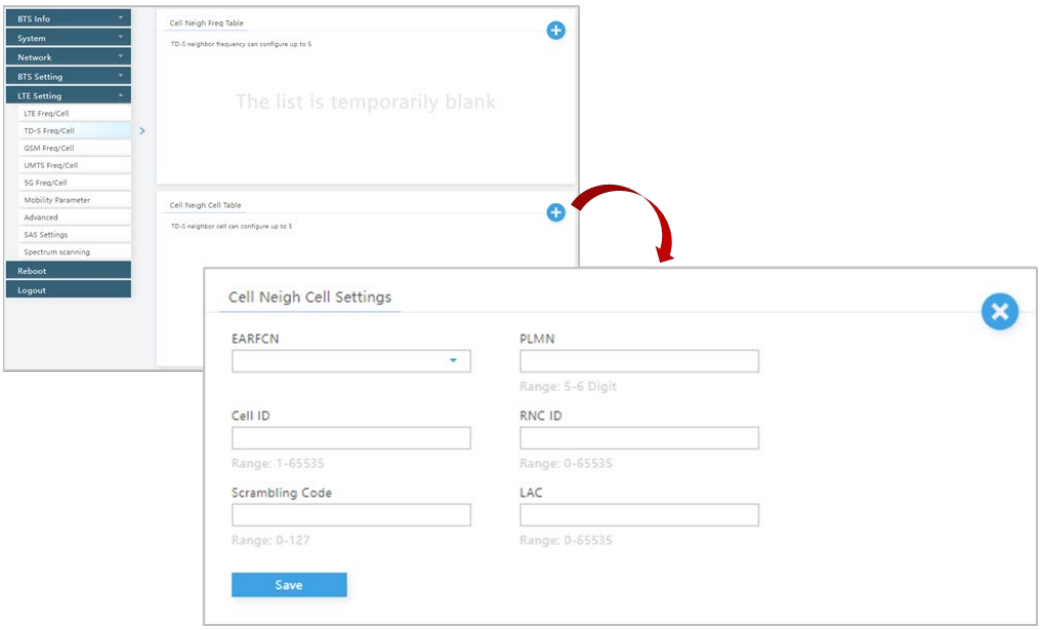


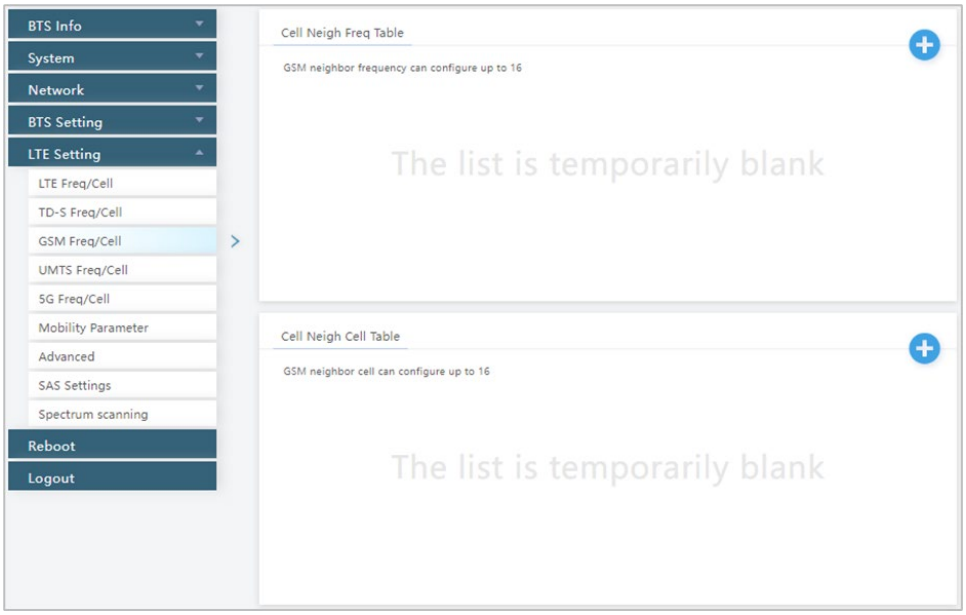
Table 2-15: TD-S Neighbor Cell Settings Fields

Field Name	Description
EARFCN	Display of the frequency point of the neighboring eNB's cell.
PLMN	The Public Land Mobile Network (PLMN) to which the neighbor cell belongs. The range is 5–6 digits.
Cell ID	A unique identification number for the cell. The range is 1–65535.
RNC ID	The neighbor cell's Radio Network Controller (RNC) ID. The range is 0–65535.
Scrambling Code	The scrambling code assigned to this neighbor cell. The range is 0–127. The scrambling code is unique to each eNB and is used to distinguish one eNB's data from another eNB's data.
LAC	Location Area Code (LAC) of the neighbor cell. The range is 0–65535.

2.8.3 Configure GSM Neighbor Settings

Using the *LTE Setting > GSM Freq/Cell* sub-menu (Figure 2-46), you can configure parameters related to how adjacent eNBs operating with GSM technology work with the Baicells LTE eNB that you are configuring. You define for the Baicells eNB how to deal with any neighboring GSM eNBs. *Section 2.8.3.1* describes how to configure GSM neighbor frequency settings and *section 2.8.3.2* describes how to configure GSM neighbor cells associated to those frequencies.

Figure 2-46: GSM Neighbor Settings (*LTE Setting > GSM Freq/Cell*)



2.8.3.1 Configure GSM Neighbor Frequency Settings

You can configure up to 16 adjacent GSM eNB frequency tables. To open the *CELL Neigh Freq Settings* window (Figure 2-47), click on the **+** (Add) icon in the *CELL Neigh Freq Settings* pane of the *LTE Setting > GSM Freq/Cell* sub-menu. The parameters are described in Table 2-16.

NOTE: Even though some of the GSM neighbor frequency setting field names are the same as in the LTE neighbor frequency setting field names, in some cases the ranges are different for GSM. See Table 2-16.

Figure 2-47: GSM Neighbor Frequency Settings

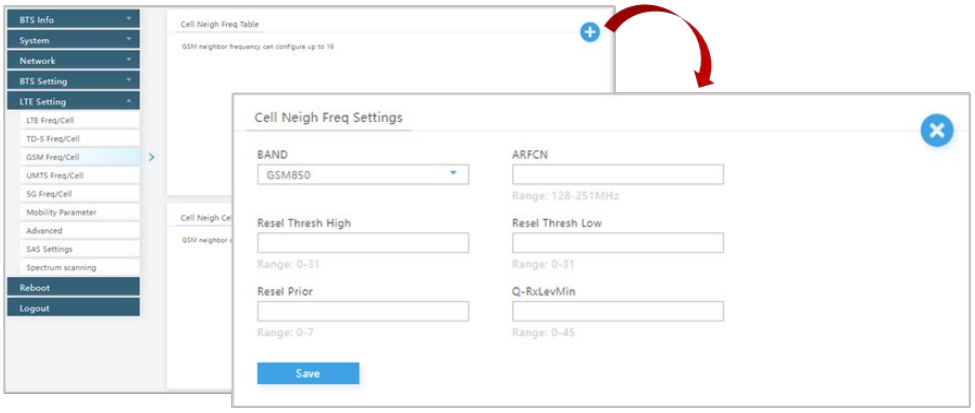


Table 2-16: GSM Neighbor Frequency Settings Fields

Field Name	Description
BAND	Channel in which the GSM neighbor eNB operates. Options are: GSM850, GSM900, DCS1800, or PCS1900.
ARFCN	In short, this is the frequency point of the neighbor eNB's frequency. The range is 128–251 MHz. The acronym stands for Absolute Radio Frequency Channel Number.
Resel Thresh High	The cell reselection threshold for a higher priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has a higher cell reselection priority than the serving cell). The range is 0–31.
Resel Thresh Low	The cell reselection threshold for a lower priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has an absolute priority lower than the serving cell). The range is 0–31.
Resel Prior	Priority of cell reselection to cells at this frequency. The range is 0–7.
Q-RxLevMin	The minimum received signal level at which a CPE detects a neighboring eNB's signal. The range is 0–45 dBm.

2.8.3.2 Configure GSM Neighbor Cell Settings

You can configure up to 16 adjacent GSM eNB cell tables. To open the *CELL Neigh Cell Settings* window (Figure 2-48), click on the **+** (Add) icon in the *CELL Neigh Cell Table* pane of the *LTE Setting > GSM Freq/Cell* sub-menu. The parameters are described in Table 2-17.

Figure 2-48: GSM Neighbor Cell Settings

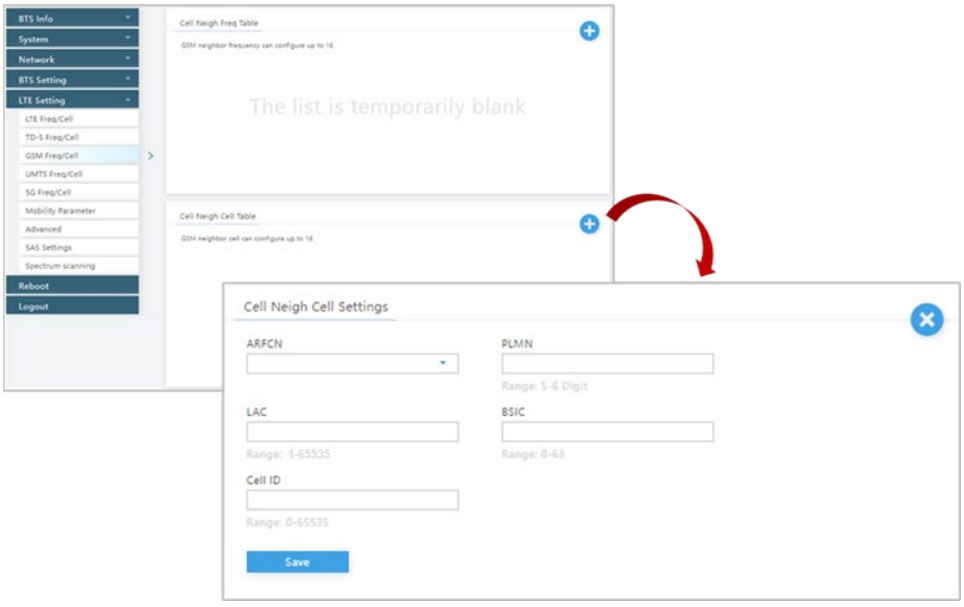


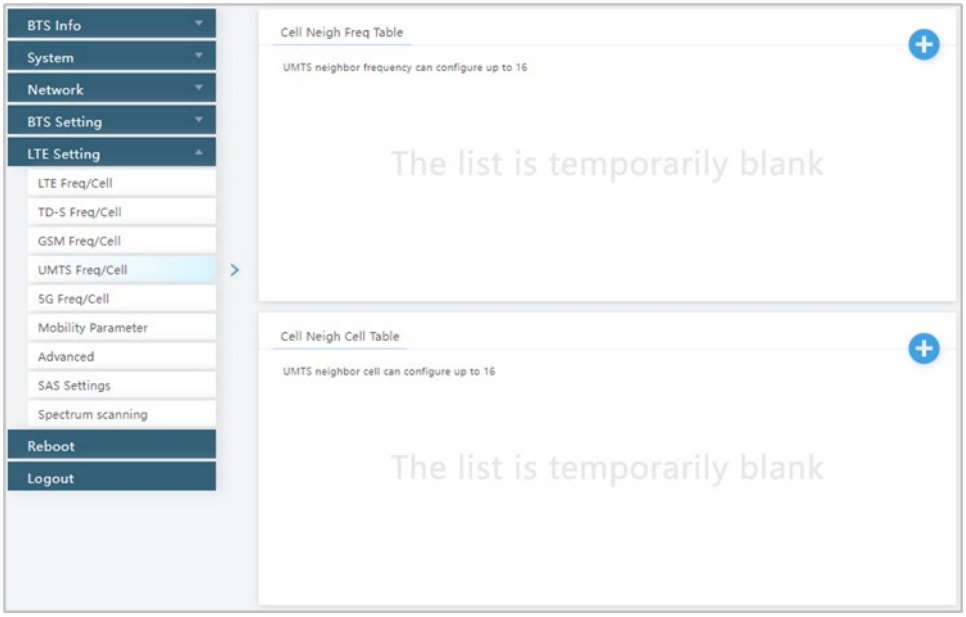
Table 2-17: GSM Neighbor Cell Settings Fields

Field Name	Description
ARFCN	Display of the frequency point of the neighbor eNB's frequency.
PLMN	The PLMN to which the neighbor cell belongs. The range is 5–6 digits.
LAC	LAC of the neighbor cell. The range is 1–65535.
BSIC	Base Station Identification Code (BSIC) of the neighbor cell. The range is 0–63.
Cell ID	A unique identification number for the cell. The range is 0–65535.

2.8.4 Configure UMTS Neighbor Settings

Using the *LTE Setting > UMTS Freq/Cell* sub-menu (Figure 2-49), you can configure parameters related to how adjacent eNBs operating with UMTS technology work with the Baicells LTE eNB that you are configuring. You define for the Baicells eNB how to deal with any neighboring UMTS eNBs. *Section 2.8.4.1* describes how to configure UMTS neighbor frequency settings and *section 2.8.4.2* describes how to configure UMTS neighbor cells associated with those frequencies.

Figure 2-49: UMTS Neighbor Settings (*LTE Setting > UMTS Freq/Cell*)



2.8.4.1 Configure UMTS Neighbor Frequency Settings

You can configure up to 16 adjacent UMTS eNB frequency tables. To open the *CELL Neigh Freq Settings* window (Figure 2-50), click on the **+** (Add) icon in the *CELL Neigh Freq Settings* pane of the *LTE Setting > UMTS Freq/Cell* sub-menu. The parameters are described in Table 2-18.

NOTE: Even though some of the UMTS neighbor frequency setting field names are the same as in the LTE neighbor frequency setting field names, in some cases the ranges are different for UMTS. See Table 2-18.

Figure 2-50: UMTS Neighbor Frequency Settings

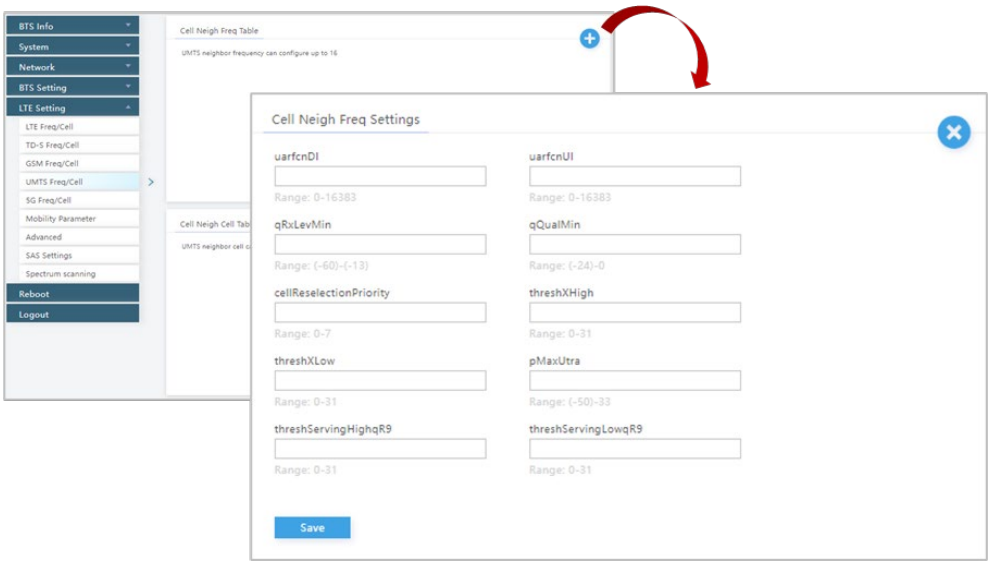


Table 2-18: UMTS Neighbor Frequency Settings Fields

Field Name	Description
uarfcnDl	Downlink frequency point of the neighbor eNB's frequency. The range is 0–16383.
uarfcnUl	Uplink frequency point of the neighbor eNB's frequency. The range is 0–16383.
qRxLevMin	Minimum acceptable signal level at the CPE before cell selection. The range is -60 dBm to -13 dBm. The value is this number x 2, e.g., if set to -60 the value is actually -120 dBm, minus the offset.
qQualMin	The minimum acceptable quality of the cell's received signal. The range is -24–0.
CellReselectionPriority	Priority of cell reselection to cells at this frequency. The range is 0–7.
threshXHigh	The cell reselection threshold for a higher priority inter-band frequency. This threshold represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has a higher reselection priority than the serving cell). The range is 0–31 dB.
threshXLow	The cell reselection threshold for a lower priority inter-band frequency. This threshold represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has an absolute priority than the serving cell). The range is 0–31 dB.
pMaxUtra	The maximum transmit power a CPE is allowed to use in the uplink, thus limiting the transmit power of the CPE within this cell. The range is -50–33.
threshServingHighqR9	High Reference Signal Received Quality (RSRQ) threshold of priority reselection. The range is 0–31.
threshServingLowqR9	Low RSRQ threshold of priority reselection. The range is 0–31.

2.8.4.2 Configure UMTS Neighbor Cell Settings

You can configure up to 16 adjacent UMTS eNB cell tables. To open the *CELL Neigh Cell Settings* window (Figure 2-51), click on the **+** (Add) icon in the *CELL Neigh Cell Table* pane of the *LTE Setting > UMTS Freq/Cell* sub-menu. The parameters are described in Table 2-19.

Figure 2-51: UMTS Neighbor Cell Settings

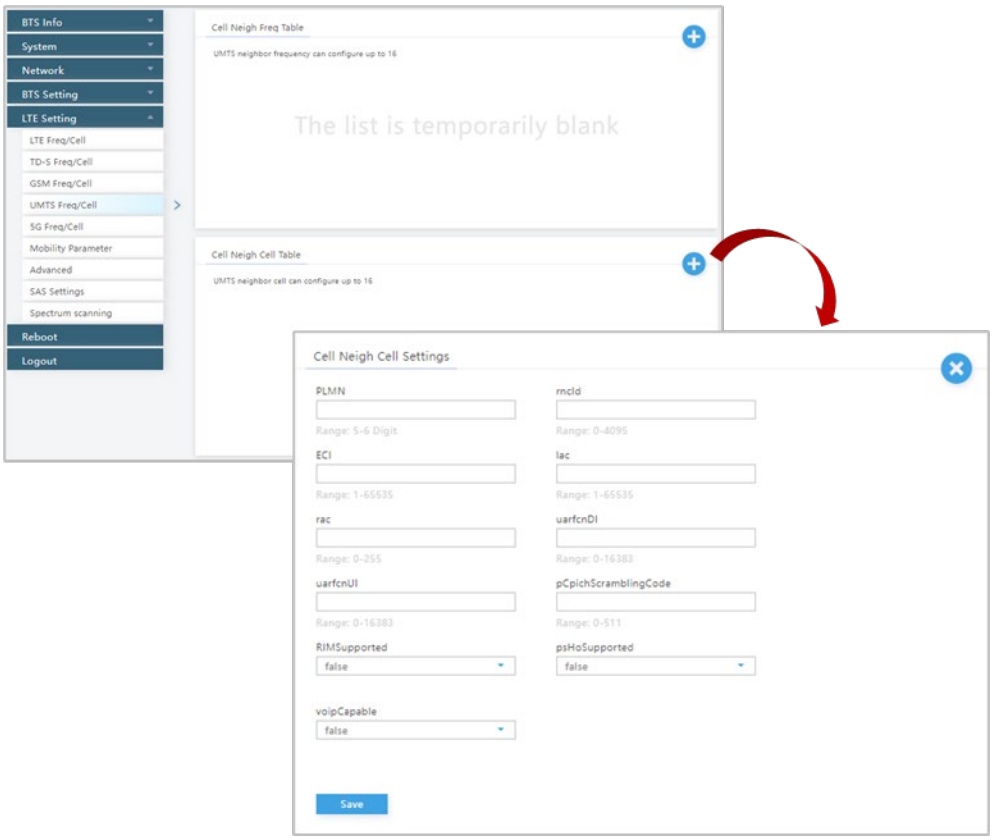


Table 2-19: UMTS Neighbor Cell Settings Fields

Field Name	Description
PLMN	The PLMN to which the neighbor cell belongs. The range is 5–6 digits.
rncId	The neighbor cell's RNC identity. The range is 0–4095.
ECI	Unique identification number for the neighbor's cell. The range is 1–65535. The Cell ID + the eNB ID x 256 comprises the ECI, which identifies a cell site in the network. Example of how Cell ID is used in calculating the ECI using ENB ID*256+cell ID: ECI=256055 if ENB ID=1000 and Cell ID=55.
lac	The neighbor cell's LAC. The range is 1–65535.
rac	The neighbor cell's Routing Area Code (RAC). The range is 0–255.
uarfcnDl	Downlink frequency point of the neighbor eNB's frequency. The range is 0–16383.

Field Name	Description
uarfcnUl	Uplink frequency point of the neighbor eNB's frequency. The range is 0–16383.
pCpichScramblingCode	The scrambling code for the main Common Pilot Channel (CPICH). The CPICH is used in UMTS to enable channel estimation. The CPICH uses a pre-defined bit sequence, and has a fixed rate of 30 Kbps with a Spreading Factor (SF) of 256. This allows the CPE to equalize the channel in order to achieve a phase reference with the Synchronization Channel (SCH) and also allows estimations in terms of power control. The range is 0–511.
RIMSupported	Used to specify whether or not a Radio Interface Module (RIM) is supported. The range is True or False.
psHoSupported	Used to specify whether or not the Packet Switching (PS) domain switchover is supported for the neighbor. The range is True or False.
voipCapable	Used to specify whether or not voice over IP (VOIP) is supported for the neighbor. The range is True or False.

2.8.5 Configure 5G Neighbor Settings

Using the *LTE Setting > 5G Freq/Cell* sub-menu (Figure 2-52), you can configure parameters related to how adjacent eNBs operating with 5G technology work with the Baicells LTE eNB that you are configuring. You define for the Baicells eNB how to deal with any neighboring 5G eNBs. Table 2-20 describes the parameters in the *function switch* pane and the *5G measurement parameters* pane. *Section 2.8.5.1* describes how to configure 5G neighbor frequency settings and *section 2.8.5.2* describes how to configure 5G neighbor cells associated with those frequencies.

NOTE: If the eNB is set to *Dual Carrier* using the *BTS Setting > Carrier Setting* sub-menu, then the *LTE Setting > 5G Freq/Cell* sub-menu GUI displays configuration tables (settings) for both Cell1 and Cell2. Figure 2-52 shows the GUI when the carrier mode is *Single Carrier*.

Figure 2-52: 5G Neighbor Settings (LTE Setting > 5G Freq/Cell)

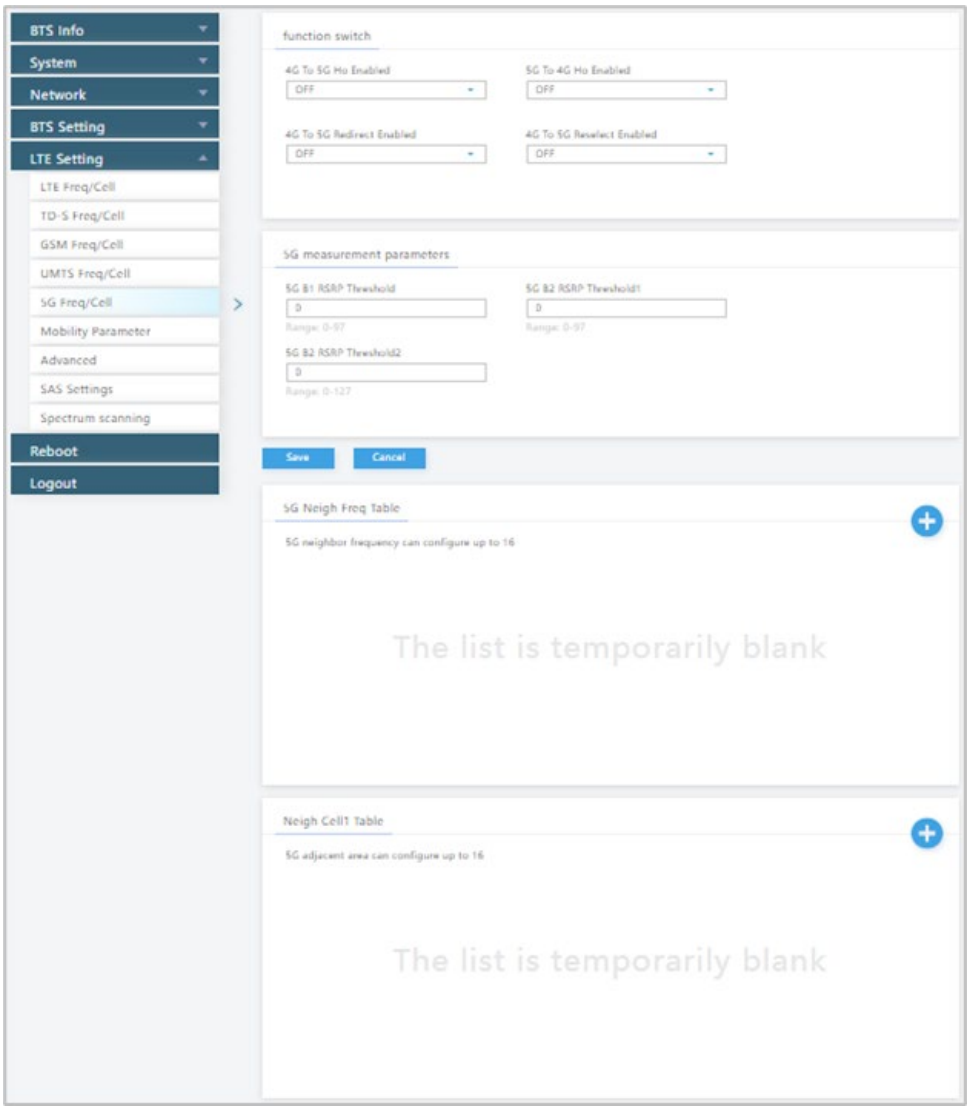


Table 2-20: 5G Neighbor Settings (*LTE Setting > 5G Freq/Cell*)

Field Name	Description
function switch	
4G to 5G Ho Enabled	Used to enable or disable 4G to 5G handover. The range is ON or OFF.
5G to 4G Ho Enabled	Used to enable or disable 5G to 4G handover. The range is ON or OFF.
4G to 5G Redirect Enabled	Used to enable or disable 4G to 5G redirection. The range is ON or OFF.
4G to 5G Reselect Enabled	Used to enable or disable 4G to 5G reselection. The range is ON or OFF.
5G Measurement Parameters	
5G B1 RSRP Threshold	Used to set the Reference Signal Received Power (RSRP) threshold for a 5G B1 event. The range is 0–97.

Field Name	Description
5G B2 RSRP Threshold1	Used to set the RSRP threshold 1 for a 5G B2 event. The range is 0–97.
5G B2 RSRP Threshold2	Used to set the RSRP threshold 2 for a 5G B2 event. The range is 0–127.

2.8.5.1 Configure 5G Neighbor Frequency Settings

You can configure up to 16 adjacent 5G eNB frequency tables. To open the *5G Neigh Freq Settings* window (Figure 2-53), click on the **+** (Add) icon in the *5G Neigh Freq Table* pane of the *LTE Setting > 5G Freq/Cell* sub-menu. The parameters are described in Table 2-21.

Figure 2-53: 5G Neighbor Frequency Settings

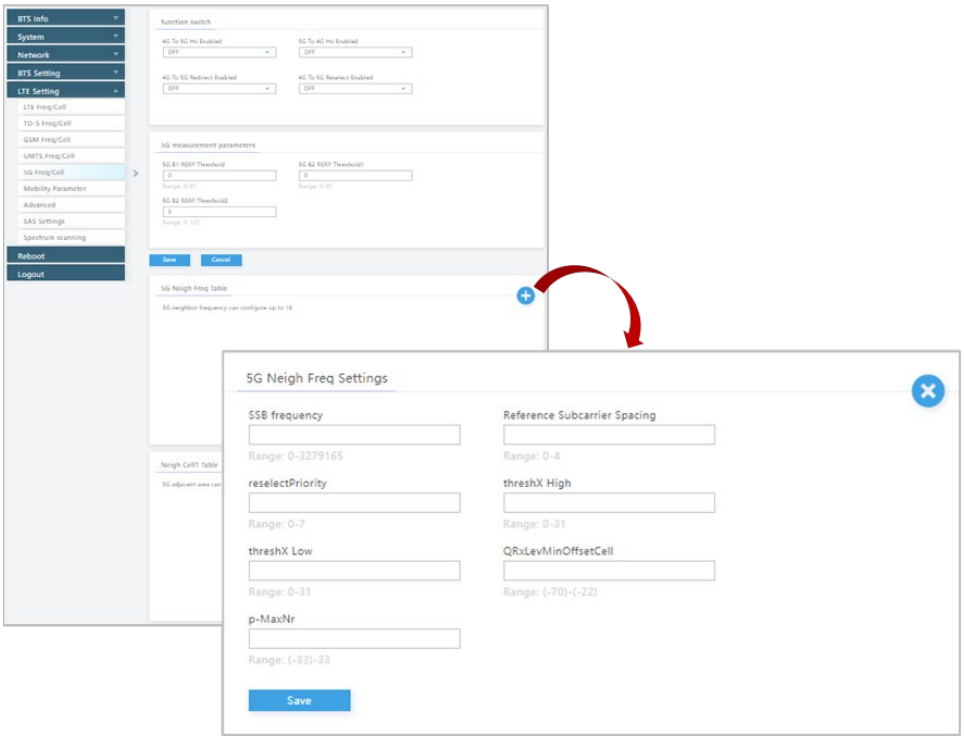


Table 2-21: 5G Neighbor Frequency Settings Fields

Field Name	Description
SSB Frequency	Used to set the absolute radio frequency channel number of the New Radio (NR) neighboring eNB's frequency. The range is 0–3279165.
Reference Subcarrier Spacing	Used to select the subcarrier spacing. The range is 0–4, where: • 0 = 15 kHz • 1 = 30 kHz • 2 = 60 kHz • 3 = 120 kHz • 4 = 240 kHz
reselectPriority	Used to set the priority of the cell reselection to the cells at this frequency. The range is 0–7. A typical value is 4.
ThreshX High	Used to specify the cell reselection threshold for a higher priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has a higher reselection priority than the serving cell). The range is 0–31 dB.
ThreshX Low	Used to specify the cell reselection threshold for a lower priority inter-band frequency. Represents the access threshold level at which the CPE leaves the serving cell and reselects another cell at the target frequency (assuming the target frequency cell has an absolute priority other than the serving cell). The range is 0–31 dB.
QRxLevMinOffsetCell	Used to specify the minimum access level for the CPE's received signal power. When the CPE's received signal power is larger than this threshold, the CPE can reside on the cell. The range is -70 to -22.
p-MaxNr	Used to limit the CPE's transmit power within this cell by specifying the maximum transmit power a CPE is allowed to use in the uplink. The range is -33 to 33.

2.8.5.2 Configure 5G Neighbor Cell Settings

You can configure up to 16 adjacent 5G eNB cell tables. To open the *Neigh Cell Settings* window (Figure 2-54), click on the **+** (Add) icon in the *Neigh Cell1 Table* pane of the *LTE Setting > 5G Freq/Cell* sub-menu. The parameters are described in Table 2-22.

Figure 2-54: 5G Neighbor Cell Settings

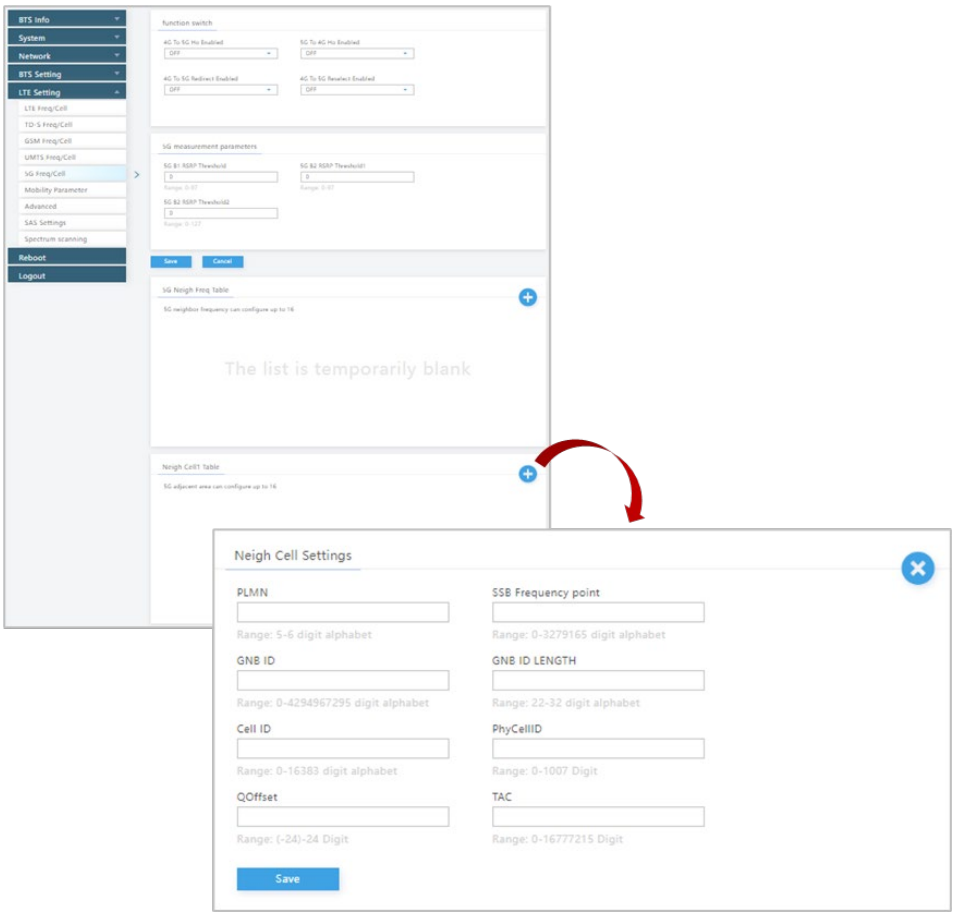


Table 2-22: 5G Neighbor Cell Settings Fields

Field Name	Description
PLMN	The PLMN to which the neighbor cell belongs. The range is 5–6 digits.
SSB Frequency point	Synchronization Signal Block (SSB) frequency point of the neighbor cell. The range is 0–3279165.
GNB ID	Unique identifier for The Next Generation NodeB (gNB). The range is 0–4294967295.
GNB ID LENGTH	Length of the gNB identifier. The range is 22–32 digits long.
Cell ID	Unique identification number for the Cell ID. The range is 0–16383.
PhyCellID	PCI of the neighbor cell. The range is 0–1007.
QOffset	Indicates the difference in signal level between the serving and neighboring eNBs, as determined by the received signal level at the CPE. If the received signal level is better from a neighboring eNB by at least this amount of difference in dB, the CPE reselects the other cell. The range is +24 to -24 dB. A typical value is 0 dB.
TAC	TAC for where the neighbor eNB is located. The TAC is used to determine the range of the paging information. The range is 0–16777215.

2.8.6 Mobility Parameter

The *LTE Setting > Mobility Parameter* sub-menu pertains to how roaming CPE sessions are handled between different eNBs in the same service area. When a CPE is actively connected to an eNB, the current eNB is referred to as the serving eNB or cell. The other eNBs in the area are referred to as either neighbor or target eNBs or cells.

The process of a device moving from cell to cell and changing over from its serving eNB to a neighbor (target) eNB is called handoff or handover. The CPE exchanges information with its serving eNB to perform cell selection and reselection based on parameters which you have set for each eNB. Refer to Figure 2-55.

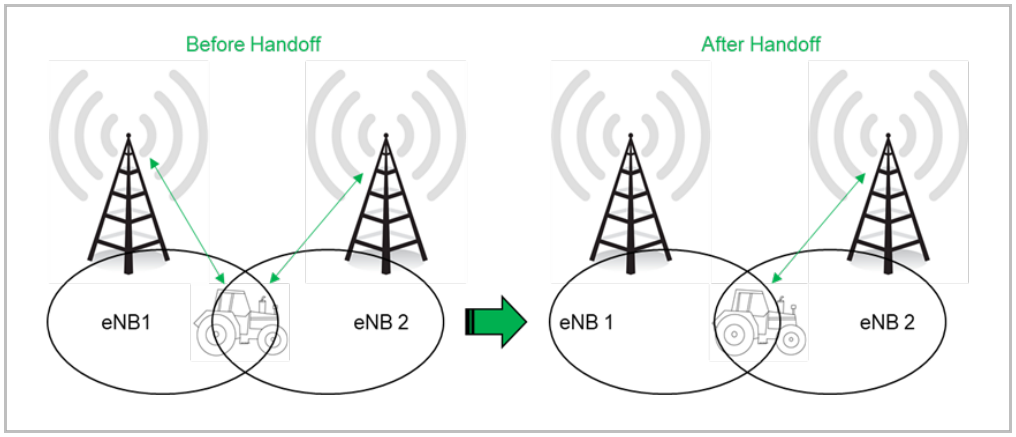
NOTE 1: The terms handoff and handover are used interchangeably in LTE.

NOTE 2: The mobility parameters must be configured for Cell1 and Cell2 if the eNB is operating in dual carrier mode.

NOTE 3: Handoff is not supported at this time on an eNB operating in HaloB mode.

NOTE 4: Cloud EPC cannot perform handoffs currently.

Figure 2-55: Handoff

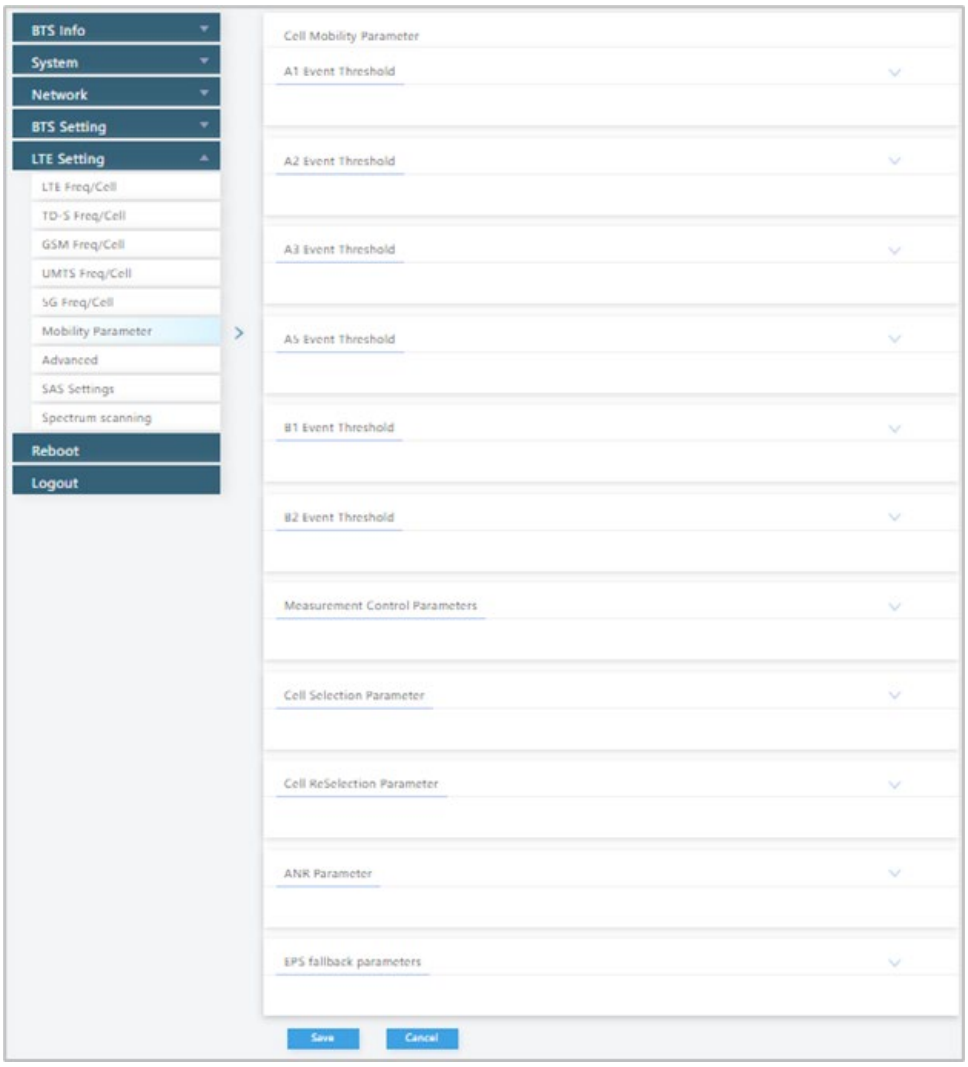


What the CPE measures that determines cell selection and reselection is the Reference Signal Received Power (RSRP) of the serving as well as neighboring eNBs. The measurements are sent periodically to the serving eNB, which then determines if the CPE would be better served by an adjacent eNB. Refer to the case study in *section 2.9* for an example of a real-world LTE-to-LTE handoff configuration.

NOTE: The *LTE Setting > Mobility Parameter* sub-menu settings described in this section are configurations that represent standard LTE deployments. Any modification to these settings should be determined only by experienced wireless professionals.

Figure 2-56 shows the various mobility parameters. In terms of LTE-to-LTE handoff, only the *A1 Event Threshold*, *A2 Event Threshold, A3 Event Threshold*, *A5 Event Threshold*, *Measurement Control*, *Cell Selection Parameter*, and *Cell ReSelection Parameter* fields are used. The *B1 Event Threshold* pertains only to 5G and UMTS adjacent cells. The *B2 Event Threshold* pertains only to TD-SCDMA, GSM and UMTS adjacent cells.

Figure 2-56: Mobility Parameter



You need to configure these mobility parameters for every adjacent eNB. If the serving eNB determines that more than one adjacent eNB meets the RSRP event thresholds, the *Cell ReSelection Parameter* settings determine to which adjacent eNB the serving eNB hands off.

To begin the configuration, click on the *A1 Event Threshold* pane to display the *A1 Event Threshold* fields. The configuration values in Figure 2-57 are the recommended settings for the eNB in this operator example. Continue to click on all the and the other event threshold panes to view their settings. Table 2-23 describes each of the event threshold fields.

Figure 2-57: A1, A2, A3, and A5 Event Thresholds

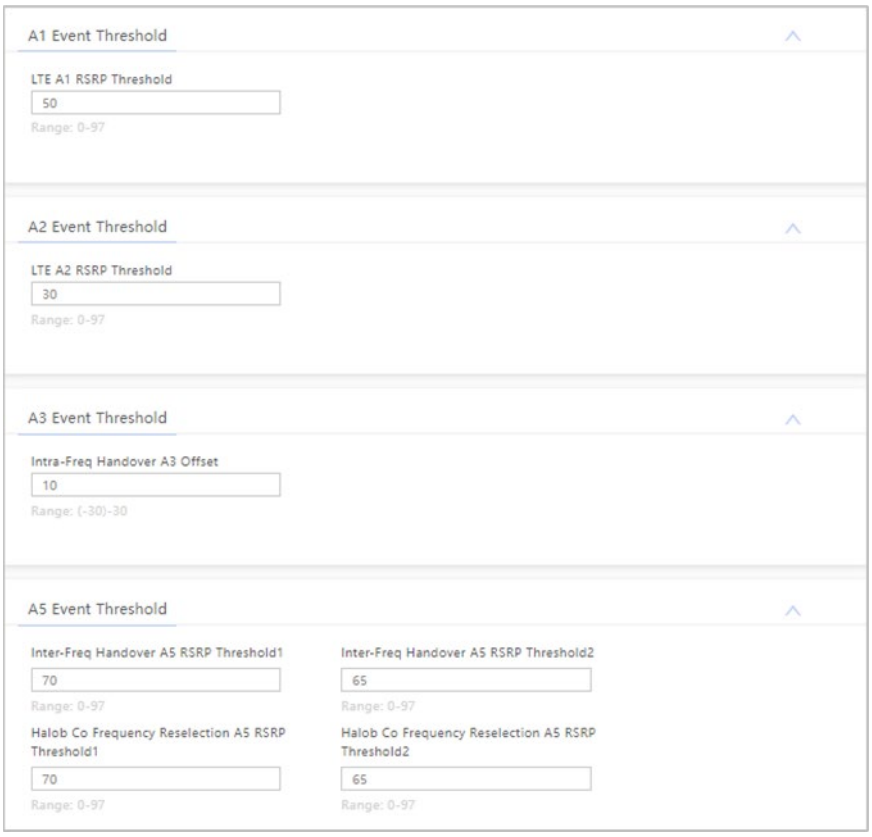


Table 2-23: A1, A2, A3, and A5 Event Threshold Fields

Field Name	Description
A1 Event Threshold	
LTE A1 RSRP Threshold	The LTE A1 event is triggered when the serving cell's RSRP becomes better than the A1 threshold. The A1 event can be used to turn off certain inter-cell measurements. The range is 0–97. The default value is 90. In this example, the recommended value is 50, which means -140 dBm + 50 = -90 dBm.
A2 Event Threshold	
LTE A2 RSRP Threshold	The LTE A2 event is triggered when the serving cell's RSRP becomes worse than the A2 threshold. The range is 0–97 dB. The default is 65. In this example, the recommended value is 30, which means -140 dBm + 30 = -110 dBm. Refer to the Baicells Tip concerning A2 settings: *https://community.na.baicells.com/t/a2-event-threshold-setting-on-enb/519?fbclid=IwAR37JgpYfIwqGevxkgophjYO9hFv7c2QNITcHT4bCcY8RNXyMcJT4pt4Y14*

Field Name	Description
A3 Event Threshold	
Intra-Freq Handover A3 Offset	The LTE A3 event is triggered when a neighbor cell becomes better than the serving cell by as much as the offset value. The offset can be either positive or negative. The range is -30 dB to 30 dB. The default is 10. In this example, the recommended value also is 10, which means 10*0.5 = 5 dB.
A5 Event Threshold	
Inter-Freq Handover A5 RSRP Threshold 1	The LTE A5 event is triggered when the serving cell becomes worse than Threshold 1 while a neighbor cell becomes better than Threshold 2. The range is 0–97. The default is 70. In the example, the recommended value is 70, which means -140 dBm + 70 = -70 dBm.
Inter-Freq Handover A5 RSRP Threshold 2	The range is 0–97. The default is 65. In this example, the recommended value is 65, which means -140 dBm + 65 = -75 dBm.
Halob Co Frequency Reselection A5 RSRP Threshold1	The A5 event's intra-frequency RSRP threshold parameter 1. The range is 0–97. In this example, the recommended value is 70.
Halob Co Frequency Reselection A5 RSRP Threshold2	The A5 event's intra-frequency RSRP threshold parameter 2. The range is 0–97. In this example, the recommended value is 65.

Next, configure the B1 and B2 event thresholds if those are necessary considerations in your network. Remember, the *B1 Event Threshold* pertains only to 5G and UMTS adjacent cells, and the *B2 Event Threshold* pertains only to TD-SCDMA, GSM and UMTS adjacent cells, not to adjacent LTE cells. The B1 and B2 event threshold fields are shown in Figure 2-58 and described in Table 2-24.

Figure 2-58: B1 and B2 Event Thresholds

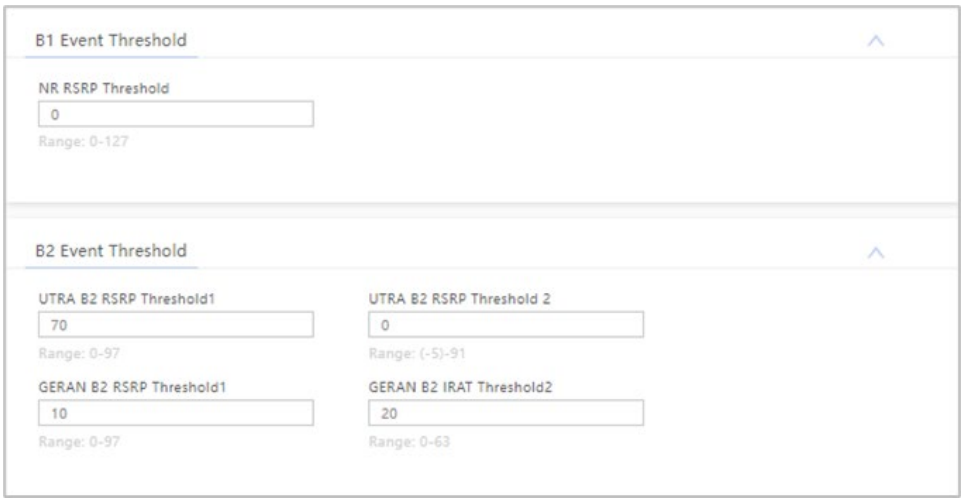


Table 2-24: B1 and B2 Event Thresholds Fields

Field Name	Description
B1 Event Threshold	
NR RSRP Threshold	The B1 event is triggered when the 5G neighbor cell's RSRP becomes better than the absolute threshold, which is used to measure the Radio Access Technology (RAT) cell with high priority. The range is 0–127.
B2 Event Threshold	
UTRA B2 RSRP Threshold1	Threshold 1 field of the UTRA Time Domain Scheduling (TDS) based B2 event. The range is 0–97 dB.
UTRA B2 RSRP Threshold2	Threshold 2 field of the UTRA TDS based B2 event. The range is -5–91 dB.
GERAN B2 RSRP Threshold1	Threshold 1 field of the GSM Edge Radio Access Network (GERAN) B2 event based on RSRP. The range is 0–97 dB.
GERAN B2 IRAT Threshold2	Threshold 2 field of the GERAN B2 event, based on Inter-Radio Access Technology (IRAT). The range is 0–63 dB.

Next, configure the measurement control parameters, which determine how frequently the CPE measures the serving and neighboring eNBs' RSRP values and at what level of hysteresis-based RSRP triggers a handoff (Figure 2-59 and Table 2-25).

The CPE evaluates the RF conditions around it and reports the information to the serving eNB. The eNB's radio resource management function evaluates the measurements and determines whether or not to hand off the session to a neighbor eNB. The parameters shown in the figure reflect the recommended settings for this operator example.

Figure 2-59: Measurement Control Parameters

Table 2-25: Measurement Control Parameters Fields

Field Name	Description
Hysteresis	Refers to the hysteresis (historical records) of the handover measurement events. The value is used to avoid the frequent triggering of cell handover evaluation due to the fluctuation in wireless signals. This setting tells the CPE "if you hear another eNB with at least this amount of dB better, initiate a handover". The lower the number, the sooner the handover is initiated. The CPE may be caused to ping-pong between eNBs if the value is set too low. Such events are tracked by the EPC, but not by the eNB. The range is 0–30 dB. The default is 0. In this example, the recommended value is 1 dB.
Time To Trigger	Length of time the target cell RSRP value is better than the serving cell before the CPE initiates a handover request. The range is 0–5120 ms. The default is 480 ms (recommended).

Next, configure the cell selection and cell reselection parameters. When the CPE selects a PLMN, it selects an appropriate cell in which to reside based on cell selection parameters you configure. Further, when the CPE is in an idle state, it monitors the signal quality of the neighbor cell and the serving cell to reselect in which cell to reside. Cell reselection includes the intra- and inter-frequency cell reselection.

Cell Selection Parameter and *Cell ReSelection Parameter* settings are shown in Figure 2-60 and described in Table 2-26. The parameters shown in the figure reflect the settings recommended in this example.

Figure 2-60: Cell Selection and Cell ReSelection Parameters

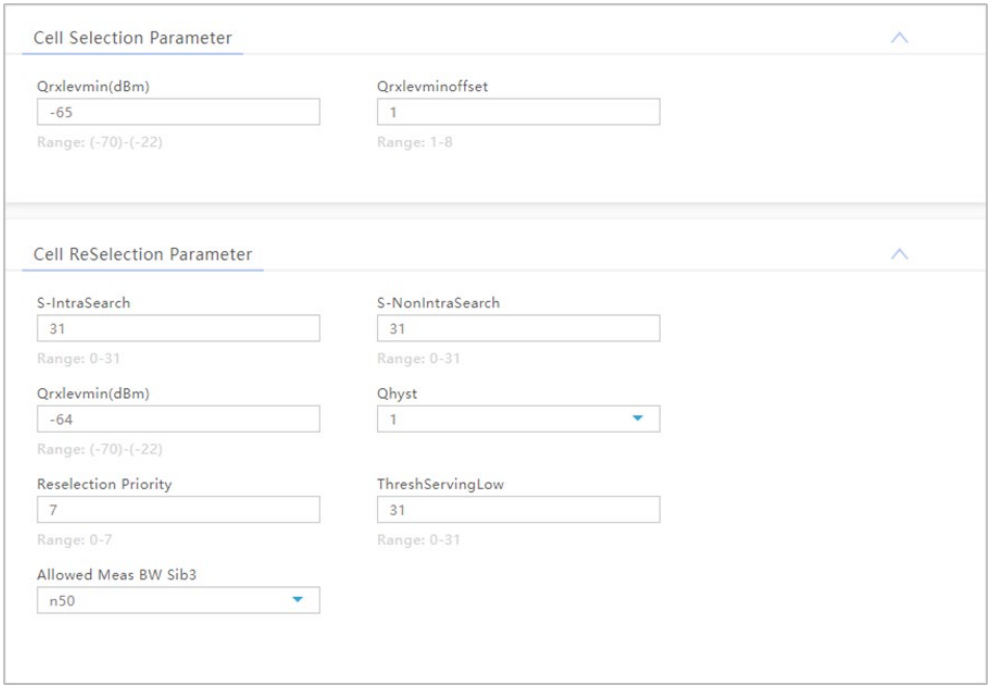


Table 2-26: Cell Selection and Cell ReSelection Parameters Fields

Field Name	Description
Cell Selection Parameter	
Qrxlevmin(dBm)	Minimum acceptable signal level at the CPE before cell selection. The range is -70 dBm to -22 dBm. The default is -60. In this example, the recommended value is -65 dBm. The value is this number x 2, e.g., if set to -65 the value is actually -130 dBm, minus the offset.
Qrxdevminoffset	Minimum level offset (difference) in RSRP at the CPE needed for cell selection. The range is 1–8 dB. The default is 1. In this example, the recommended value is 1 dB.
Cell ReSelection Parameter	
S-IntraSearch	Intra-band measurement threshold that must be met before the CPE reselects a neighbor eNB. The range is 0–31. In this example, the recommended value is 31, which means 31*2 = 62 dB.
S-NonIntraSearch	Inter-band measurement threshold that must be met before the CPE reselects a neighbor eNB. The range is 0–31. In this example, the recommended value is 31, which means 31*2 = -62 dB.
Qrxlevmin(dBm)	Minimum level for reselection. The range is -70 to -22. In this example, the recommended value is -64, which means -64*2 = -128 dBm.
Qhyst	Delay time for reselection. The range is 0–24 dB. In this example, the recommended value is 1 dB.
Reselection Priority	Priority for reselection. The range is 0–7. In this example, the recommended value is 7.
ThreshServingLow	Threshold for selection to cells of lower priority. The range is 0–31 dB. In this example, the recommended value is 31 dB.
Allowed Meas BW Sib3	Measurement bandwidth allowed. Options are n6, n15, n25, n50, n75, or n100. The default value is n50.

Next, configure the Automatic Neighbor Relation (ANR) settings in the *ANR Parameter* pane of the *LTE Setting > Mobility Parameter* sub-menu (Figure 2-61). The settings are described in Table 2-27.

Figure 2-61: ANR Parameter

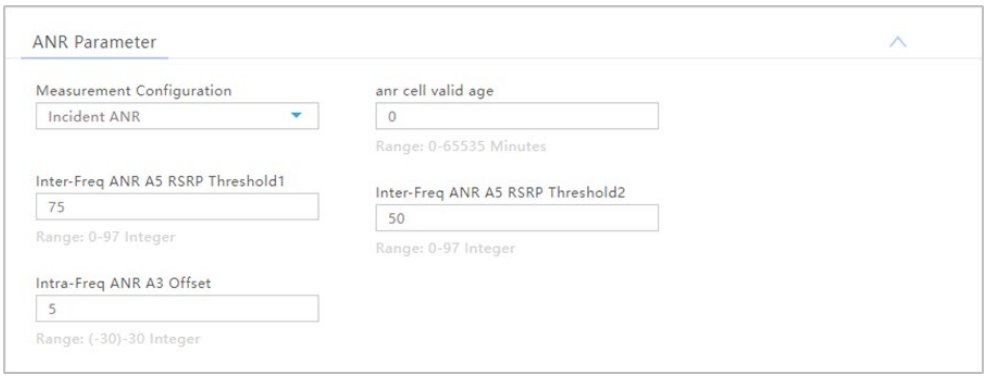


Table 2-27: ANR Parameter Fields

Field Name	Description
Measurement Configuration	Used to select the measurement configuration mode. Options are: • Measurement Disable • Periodic ANR • Incident ANR
anr cell valid age	Aging time. The range is 0–65535 minutes.
Inter-Freq ANR A5 RSRP Threshold1	This parameter displays if *Measurement Configuration* is set to *Incident ANR*. The first threshold of ANR A5 event for inter-frequency handover. The range is 0–97.
Inter-Freq ANR A5 RSRP Threshold2	This parameter displays if *Measurement Configuration* is set to *Incident ANR*. The second threshold of ANR A5 event for inter-frequency handover. The range is 0–97.
Intra-Freq ANR A3 Offset	This parameter displays if *Measurement Configuration* is set to *Incident ANR*. The offset of ANR A3 event for intra-frequency handover. The offset can be either positive or negative. The range is -30 dB to 30 dB.

Finally, enable or disable the Evolved Packet System (EPS) fallback switch using the *EPS fallback parameters* pane of the *LTE Setting > Mobility Parameter* sub-menu (Figure 2-62).

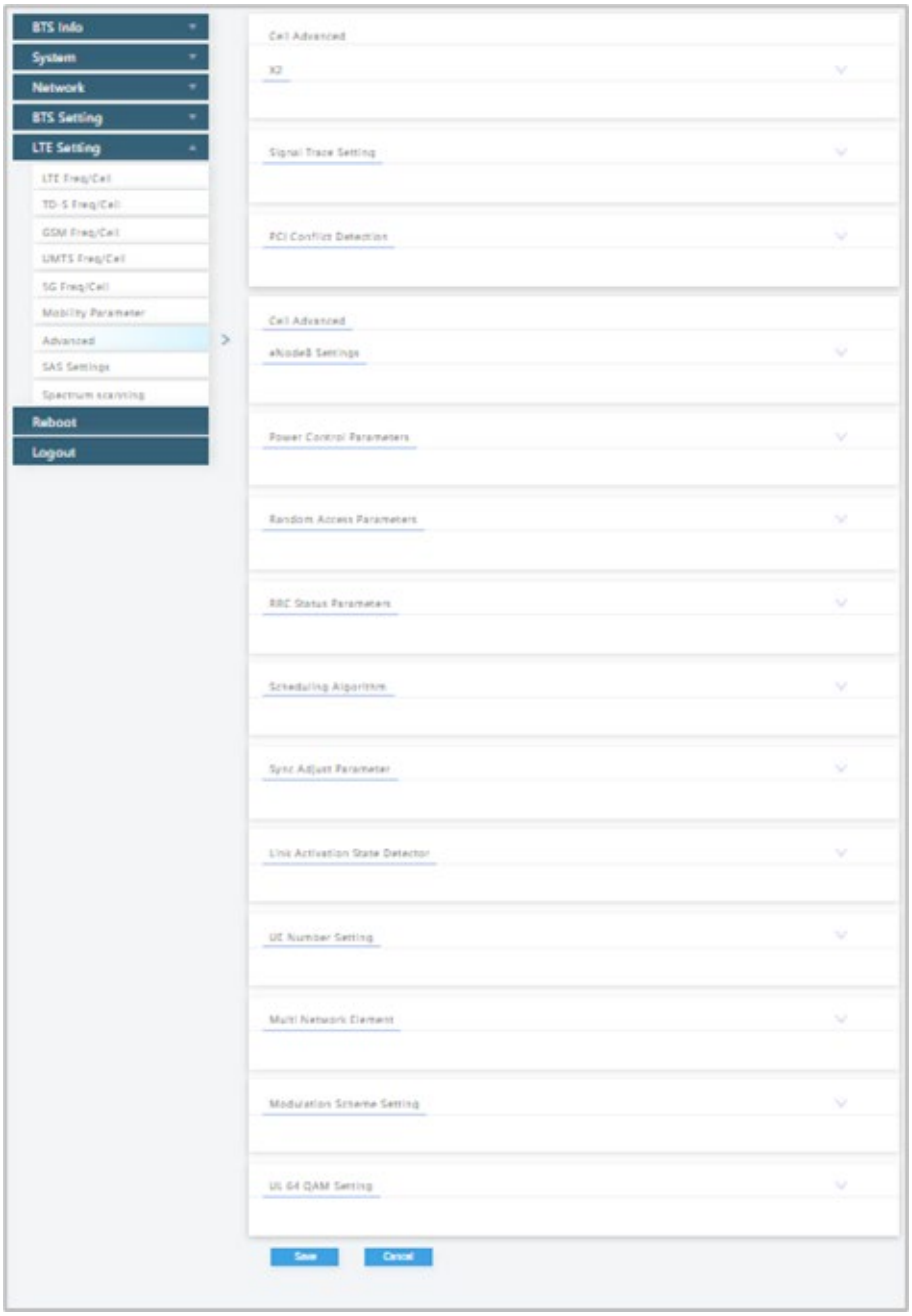
Figure 2-62: EPS Fallback Parameters

2.8.7 Advanced

Caution: Many, if not all, of the *Advanced* settings should be left with their default values. Any modifications should be determined only by experienced wireless professionals.

The *LTE Setting > Advanced* sub-menu (Figure 2-63) parameters are primarily used to fine-tune the RF settings and to configure special features, which are explained in this section.

Figure 2-63: Advanced



2.8.7.1 X2

An X2 interface is a logical interface which may be enabled for intra-LTE eNB handovers when the MME being used for the CPE is the same for both the serving and the target eNB. If enabled, the two eNBs can communicate directly with one another without communicating through a Radio Network Controller (RNC). The X2 starts buffering on the target eNB in advance of a handover.

By default, the X2 interface parameter in the *X2* pane of the *LTE Setting > Advanced* sub-menu is disabled (OFF). The recommended setting is *ON*. To enable X2, select *ON* from the drop-down menu (Figure 2-64).

Figure 2-64: X2

2.8.7.2 Signal Trace Setting

The *Signal Trace Setting* pane (Figure 2-65) of the *LTE Setting > Advanced* sub-menu is typically used for troubleshooting CPE attachment and handover issues. During a signal trace, Radio Resource Control (RRC) protocol and Stream Control Transmission Protocol (SCTP) packets are captured in real-time. The packets are then sent to a remote computer running Wireshark* or to a Local Baicells OMC** so the displayed data can be analyzed. The parameters are described in Table 2-28. You do not need to reboot the eNB to initiate the trace.

*NOTE 1: For more information about the Wireshark app, refer to *https://www.wireshark.org/*.

**NOTE 2: Local Baicells OMC (or BaiOMC) is covered in the *BaiOMC Operator Administrator User Guide*. The Baicells CloudCore does not support the Signal Trace Setting feature.

The RRC protocol controls the CPE and eNB over-the-air communications, and is especially important during mobility scenarios as a mobile user is handed off from one eNB to another. SCTP is a transport protocol layer for the S1-MME signaling bearer, and is responsible for EPS bearer setup/modification/release, handover procedures, Non-Access Stratum (NAS) signaling transport, and paging procedures.

Figure 2-65: Signal Trace Setting

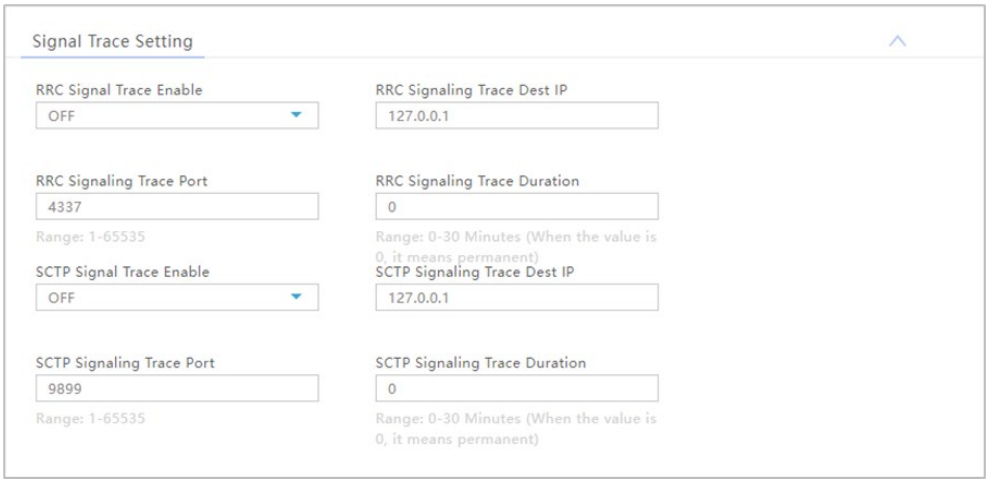


Table 2-28: Signal Trace Setting Fields

Field Name	Description
RRC Signaling Trace Enable	Used to enable (ON) or disable (OFF) the RRC signaling trace function. Default is OFF.
RRC Signaling Trace Dest IP	The IP address of the computer where RRC signaling trace data will be sent, which must be communicated with the eNB. The default value is 127.0.0.1, which should be changed.
RRC Signaling Trace Port	The computer's port number where RRC signaling trace data will be sent. The range is 1–65535, and the default is 4337. NOTE: For MAC computers, if there is an existing MAC package (directory) make sure you use a different port number for the RRC package.
RRC Signaling Trace Duration	Used to define the RRC signaling trace duration. The range is 0-30 minutes. A value of zero (0) means permanent (continuous).
SCTP Signaling Trace Enable	Used to enable (ON) or disable (OFF) the SCTP signaling trace function. Default is OFF.
SCTP Signaling Trace Dest IP	The IP address of the computer where SCTP signaling trace data will be sent, which must be communicated with the eNB. The default value is 127.0.0.1, which should be changed.
SCTP Signaling Trace Port	The computer's port number where SCTP signaling trace data will be sent. The range is 1–65535, and the default is 9899.
SCTP Signaling Trace Duration	Used to define the SCTP signaling trace duration. The range is 0-30 minutes. A value of zero (0) means permanent (continuous).

2.8.7.3 PCI Conflict Detection

Physical Cell Identification (PCI) is an essential Layer 1 cell identity for each cell site in the network. PCIs are used to scramble data to aid mobile phones in separating information coming from different transmitters. As an LTE network may contain a much larger number of cells than the 504 available PCI values, the same PCI must be reused by several cells. However, the CPE cannot distinguish between two cells if they both have the same PCI and frequency, which causes a PCI conflict. A good PCI plan, which is crucial for QoS, can be applied to avoid PCI conflicts, but in a dense network, it can be difficult to create a PCI plan that avoids all PCI conflicts. Additionally, network changes, such as increased power of a cell and variable radio conditions, can also lead to PCI conflicts. PCI conflicts can lead to a dropped call rate increase due to failed handovers, as well as an increase in blocked calls and channel interference.

The *PCI Conflict Detection* pane (Figure 2-66) of the *LTE Setting > Advanced* sub-menu is used to manage PCI conflicts in the network. The parameters are described in Table 2-29.

Figure 2-66: PCI Conflict Detection

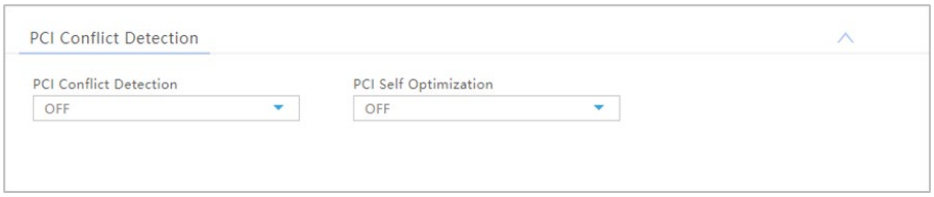


Table 2-29: PCI Conflict Detection Fields

Field Name	Description
PCI Conflict Detection	Used to enable (ON) or disable (OFF) detection and reporting of the PCI conflict or PCI confusion alarm information to the OMC. The default is OFF. NOTE: If the parameter value is modified, the eNB must be rebooted for the change to take effect.
PCI Self Optimization	Used to enable (ON) or disable (OFF) modifying the source cell's PCI when a PCI conflict or PCI confusion occurs. The default is OFF. NOTE: If the parameter value is modified, the eNB must be rebooted for the change to take effect.

2.8.7.4 eNodeB Settings

The *eNodeB Settings* pane of the *LTE Setting > Advanced* sub-menu is used to name the eNB you are configuring, as shown in Figure 2-67 and described in Table 2-30.

Figure 2-67: eNodeB Settings

Table 2-30: eNodeB Settings Fields

Field Name	Description
eNodeB Name	The name you use for the eNB. The range is 0 to 48 characters (using upper-case letters A–Z, lower-case letters a–z, and digits 0-9) ' space ( ) + , - . / : ? string. Note that ":" and "+" cannot be configured continuously.

2.8.7.5 Power Control Parameters

The power control parameters you can configure help to limit CPE transmit power to the eNB, including the power of the transmitted reference signals. The parameters factor into the overall RF link budget. The settings for these parameters are in the *Power Control Parameters* pane of the *LTE Setting > Advanced* sub-menu, and are shown in Figure 2-68 and described in Table 2-31.

Figure 2-68: Power Control Parameters

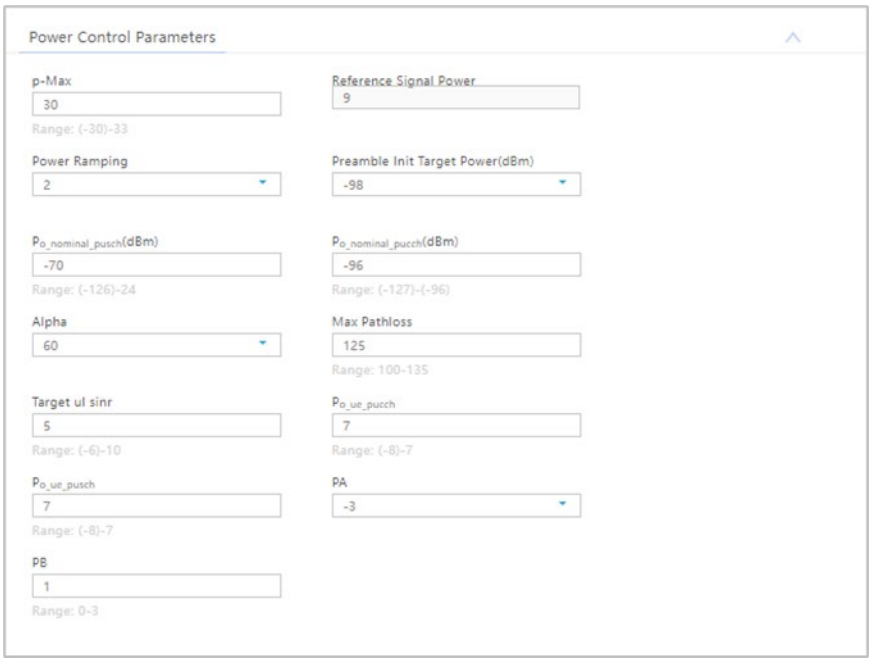


Table 2-31: Power Control Parameters Fields

Field Name	Description
p-Max	The maximum power that a CPE can transmit in this cell. The range is -30 dB to 33 dB.
Reference Signal Power	Transmit power of the reference signals. Auto-set to 9.
Power Ramping	Step size of the Physical Random-Access Channel's (PRACH's) power index broadcast to the CPEs via a Layer 1 channel used by CPEs to access the mobile network for call setup and bursty data transmission. Options are 0, 2, 4, or 6.
Preamble Init Target Power(dBm)	Initial power of the Physical Random-Access Channel (PRACH). The range is -90 to -120 dBm.
Po_nominal_pusch(dBm)	Physical Uplink Shared Channel (PUSCH) carries user data. PUSCH supports Quadrature Phase Shift Keying (QPSK) and 16 Quadrature Amplitude Modulation (QAM), with 64 QAM being optional. The range is -126 to 24 dBm.
Po_nominal_pucch(dBm)	Physical Uplink Control Channel (PUCCH) is used to carry Uplink Control Information (UCI). LTE CPEs can never transmit both PUCCH and Physical Uplink Shared Channel (PUSCH) during the same subframe. The range is -127 dB to -96 dBm.

Field Name	Description
Alpha	Power control loss compensation factor, which controls the CPE power. The range is 0 to 100.
Max Pathloss	Maximum threshold at which the CPE determines not to transmit to the eNB based on pathloss. Pathloss is the difference between the transmitted reference signal information and the actual received signal power. The range is 100 to 135.
Target ul sinr	The uplink target Signal-to-Interference-Plus-Noise Ratio (SINR) corresponding to the maximum pathloss. The range is -6 dB to 10 dB.
Po_ue_pucch	Initial CPE transmit power when using Physical Uplink Control Channel (PUCCH). The range is -8 dB to 7 dB.
Po_ue_pusch	Initial CPE transmit power when using Physical Uplink Shared Channel (PUSCH). The range is -8 dB to 7 dB.
PA	Physical Downlink Shared Channel (PDSCH) is the main data bearing channel. Power boosting the reference signal is allocated to CPEs on a dynamic and opportunistic basis. The relative PDSCH power is determined by two computed parameters: P_A and P_B. Traffic loading must be balanced with controlling interference to neighboring cells. Options are: -6, -4.77, -3, -1.77, and 0–3. The recommended value is -3.
PB	See description for field “PA”. The range is 0–3.

To optimize channel conditions on the eNB, please refer to the BaiTip posted on the Baicells website: *https://community.na.baicells.com/t/recommened-advanced-settings-on-the-enb-to-optimise-channel-conditions/531*

2.8.7.6 Random Access Parameters

The preamble format to be used in a specific cell is messaged from the eNB to the CPEs using a Physical Random-Access Channel (PRACH) configuration index. The CPE uses the preamble to access the network when it is first powered on.

The settings in the *Random Access Parameters* pane of the *LTE Setting > Advanced* sub-menu are shown in Figure 2-69 and explained in Table 2-32.

Figure 2-69: Random Access Parameters

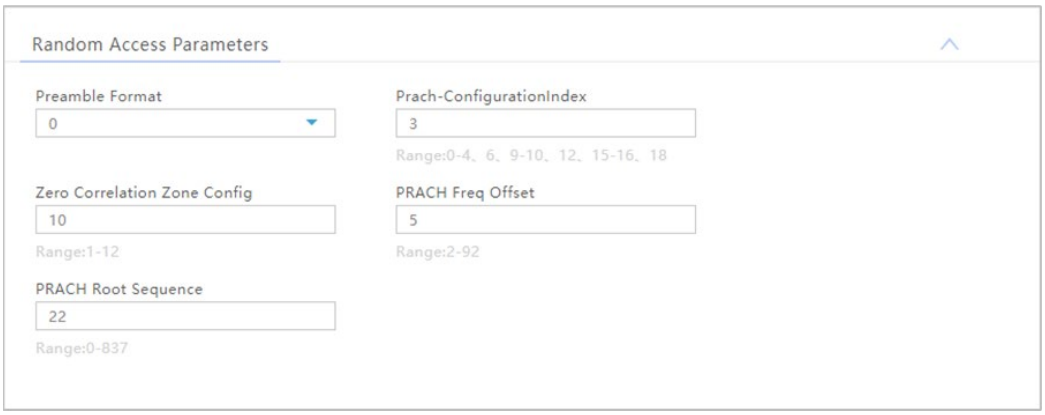


Table 2-32: Random Access Parameters Fields

Field Name	Description
Preamble Format	Packet preamble format [based on the Physical Random-Access Channel (PRACH) index] to be used for this cell and communicated to CPEs. Options are 0 and 4.
Prach-Configuration Index	The PRACH configuration index number that is broadcast to the CPEs via SIB2. Options are: 0–4, 6, 9, 10, 12, 15, 16, or 18.
Zero Correlation Zone Config	Specifies the cyclic shift intervals to generate the preamble sequence. • If *Preamble Format* is set to *0*, the range is 1–12. • If *Preamble Format* is set to *4*, the range is 2–6. The default is 10. Refer to the BaiTip on this setting: *https://community.na.baicells.com/t/baitip-of-the-day-december-14th-2016-subframes-and-special-subframes/163*
PRACH Freq Offset	Determines the location of the PRACH preamble in the frequency domain. Range: 2–92.
PRACH Root Sequence	Index broadcast by the eNB and used by CPEs to calculate the preamble they should use to attach to the eNB. Range: 0–837.

2.8.7.7 RRC Status Parameters

Using the *RRC Status Parameters* pane of the *LTE Setting > Advanced* sub-menu, you configure parameters related to how the RRC protocol in the air interface control plane establishes, maintains, and releases an RRC connection between CPEs and the eNB. If the *Ue Inactivity Timer* field is set to 0, the timer does not take effect. The CPE inactive status duration is equal to the RRC inactivity timer times the maximum expiry count. Refer to Figure 2-70 and Table 2-33.

Figure 2-70: RRC Status Parameters

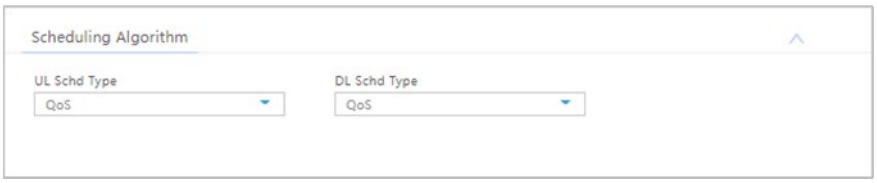
Table 2-33: RRC Status Parameters Fields

Field Name	Description
Ue Inactivity Timer	Expire time of the CPE inactive status timer(s). The range is 0–4294967 seconds. If set to 0, the timer does not take effect.
Max Expiry Count	Maximum number of times the CPE's inactive status timer expires. The range is 1–65535 times.

2.8.7.8 Scheduling Algorithm

The fields in the *Scheduling Algorithm* pane of the *LTE Setting > Advanced* sub-menu are important for smooth RF operation and can impact key performance indicators such as cell throughput, cell edge users, Voice Over IP (VoIP) capacity, and data Quality of Service (QoS). Two scheduling strategies are available: Round Robin (RR) and QoS. The two scheduling strategies apply to both uplink and downlink, and the scheduling strategies don't have to be the same. For example, uplink could be set to RR and downlink could be set to QoS. The most common scheduling strategy is RR, which allocates resources to all CPEs equally, and neither QoS nor memory is considered. With QoS scheduling, different QoS is provided for different data bearer categories. Each data bearer category is associated with a QoS Class Identifier (QCI). RR is the default type for both UL and DL. Refer to Figure 2-71.

Figure 2-71: Scheduling Algorithm



2.8.7.9 Sync Adjust Parameter

The settings in the *Sync Adjust Parameter* pane of the *LTE Setting >Advanced* sub-menu are used to help the system compensate for packet delay in the uplink and downlink process.

Do not modify the *Sync Adjust Value* field. Refer to Figure 2-72.

Figure 2-72: Sync Adjust Parameter

2.8.7.10 Link Activation State Detector

The *Link Activation State Detector* pane of the *LTE Setting > Advanced* sub-menu is used to enable or disable a link watchdog. If you select *ON*, a watchdog action checks the CPE every "x" minutes to see if it is connected or disconnected from the EPC, LAN, or both, and if disconnected after "x" number of minutes the watchdog performs a reboot of the CPE. If you select *OFF*, the watchdog does not reboot the CPE. Refer to Figure 2-73 and Table 2-34.

Figure 2-73: Link Activation State Detector

Table 2-34: Link Activation State Detector Fields

Field Name	Description
Link Keep Alive	Enable or disable (*ON* or *OFF*) the link activation state detector between the CPE and EPC, LAN, or both. The default is *ON*.
Link Keep Alive Timer	Select 5, 10, or 15 minutes for the link keep alive timer. The default is 10 minutes.

2.8.7.11 UE Number Setting

The *UE Number Setting* pane of the *LTE Setting > Advanced* sub-menu is used to configure the maximum number of connected CPEs and/or active CPEs that can access the eNB (Figure 2-74). The values cannot exceed the eNB's capabilities. The range for connected users is 0–512. The range for active users is 0–256.

Figure 2-74: UE Number Setting

2.8.7.12 Multi Network Element

If you have multiple network elements providing the same service, use the settings in the *Multi Network Element* pane of the *LTE Setting > Advanced* sub-menu to bind the eNB to:

- A specific S1 Control plane (S1-C);
- A specific S1 User plane (S1-U) (e.g., operator has Local EPC as well as CloudCore EPC);
- An X2 interface (eNB-to-eNB handoff scenarios); or
- A TR-069 interface (multiple Automatic Configuration Servers (ACSs)).

Refer to Figure 2-75 and Table 2-35.

Figure 2-75: Multi Network Element

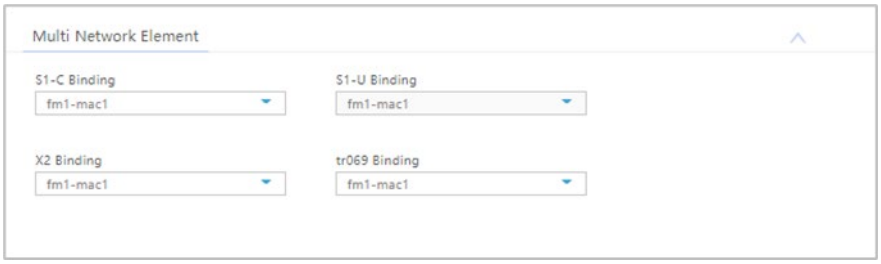


Table 2-35: Multi Network Element Fields

Field Name	Description
S1-C Binding	Select the binding interface for the S1-C. The only option currently available is fm1-mac-1.
S1-U Binding	Select the binding interface for S1-U. The only option currently available is fm1-mac1.
X2 Binding	Select the binding interface for X2. The only option currently available is fm1-mac1.
tr069 Binding	Select the binding interface for TR-069. The only option currently available is fm1-mac1.

2.8.7.13 Modulation Scheme Setting

The *Modulation Scheme Setting* pane of the *LTE Setting > Advanced* sub-menu is used to enable or disable the DL 256 QAM modulation scheme (Figure 2-76). The default is ON.

Figure 2-76: Modulation Scheme Setting

2.8.7.14 UL 64 QAM Setting

The *UL 64 QAM Setting* pane of the *LTE Setting > Advanced* sub-menu is used enable or disable the UL 64 QAM modulation scheme (Figure 2-77). The default is ON.

Figure 2-77: UL 64 QAM Setting

2.8.8 SAS Settings

Reference: *SAS Deployment User Guide*

The Nova846 eNB supports Citizens Broadband Radio Service (CBRS) and the shared Spectrum Access System (SAS). The CBRS SAS is an operating solution available only in the United States. The solution requires a working knowledge of SAS, preparation of personnel and equipment, and coordinated configuration across device GUIs, the OMC, and the selected SAS vendor's portal. For this reason, Baicells created the *SAS Deployment User Guide* to assist operators in planning their deployment of SAS.

The *SAS Deployment User Guide* provides detailed information about all SAS requirements and configurations, and fully explains how to use the *LTE Setting > SAS Settings* sub-menu to support SAS. The following information provides a brief overview only.

The CBRS band covers 3.55–3.65 GHz and was officially launched in January 2020. Operators must sign up with a SAS provider for services to handle the dynamic frequency assignment and release process. Baicells provides FCC Part 96 certified eNBs and CPEs as CBRS Service Devices (CBSDs) that can operate within the FCC rules for CBRS, and certification is an ongoing process as new products are introduced. The SAS vendors currently available to manage spectrum usage are Amdocs, Federated Wireless, and Google.

The Baicells eNBs use domain proxy (DP) to connect to the SAS server by leveraging the existing connection with the OMC. All eNBs need to be connected to the OMC in order to connect to the SAS.

The following are the current software levels for SAS to work:

- Nova846: BaiBLN_3.0
- OMC: BaiOMC 8.3.7

NOTE: Legacy Gen 1 CPEs do not support SAS.

There are two SAS setting registration types: Single-step and Multi-step. The difference in these types is that in Single-step registration, all configuration is accomplished on the eNB GUI itself and there is no need to use a SAS portal. The Multi-step registration type has fewer fields for configuring the eNB, but the rest of the configuration must be accomplished using the SAS portal. Each SAS vendor provides their own GUI to assist you in using their SAS portal.

In the eNB GUI, the *LTE Setting > SAS Settings* sub-menu opens by default as disabled (*OFF*). Once SAS is enabled, the parameters for *Band, Bandwidth, Frequency,* and *Power Modify* in the *BTS Info > Quick Setting* menu become greyed out; the eNB uses the configuration based on the SAS settings response. However, you can configure your preferences for these settings by selecting a preferred *Frequency Selection Logic*, *Preferred Bandwidth*, *Preferred Power*, and *Preferred Frequency*. All of these preferences are explained in the *SAS Deployment User Guide*.

2.8.9 Spectrum Scanning

Reference: *Spectrum Analysis User Guide*

The *LTE Setting > Spectrum scanning* sub-menu is used to perform spectrum scans and helps you to see what is happening in the RF spectrum. The scans can also be used to analyze signal amplitude (strength) as it varies by signal frequency on the uplink. You can use this information to determine the best frequency to use and identify where there may be interference. Frequency scanning encompasses both frequency and time information.

NOTE: Refer to the *Spectrum Analysis User Guide* for details about how to configure the eNB to enable use of this feature.

2.9 Real-World LTE-to-LTE Handoff Configuration Example

Following is an example of the LTE mobility-related parameters, based on eNB software version BaiBLN_3.0 or higher, to illustrate how the system performs based on the configuration settings.

When you click on the **+** (Add) icon in the *Cell Neigh Freq Table* pane of the *LTE Setting > LTE Freq/Cell* sub-menu, the *Cell Neigh Freq Settings* window displays. Figure 2-78 shows how the *Cell Neigh Freq Settings* are configured in this customer example. When you click on the **+** (Add) icon in the *Cell Neigh Cell Table* pane of the *LTE Setting > LTE Freq/Cell* sub-menu, the *Cell Neigh Cell Settings* window displays. Figure 2-79 shows how the *Cell Neigh Cell Settings* are configured in this customer example.

Figure 2-78: LTE Cell Neigh Freq Settings Example

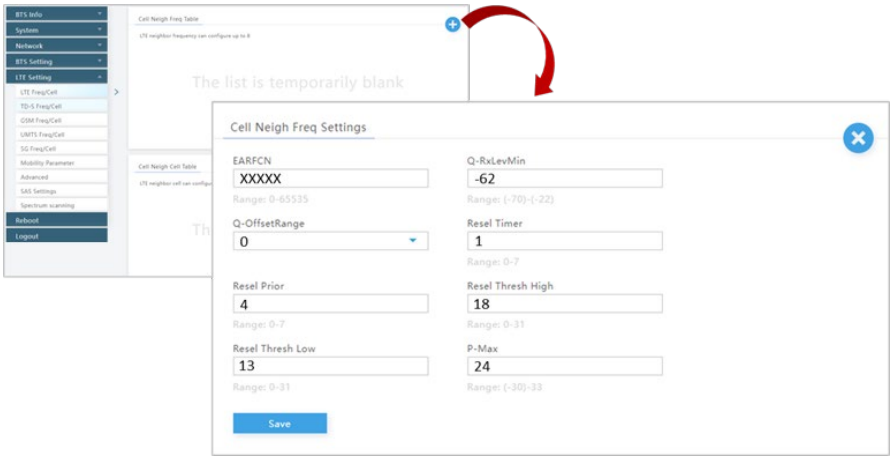
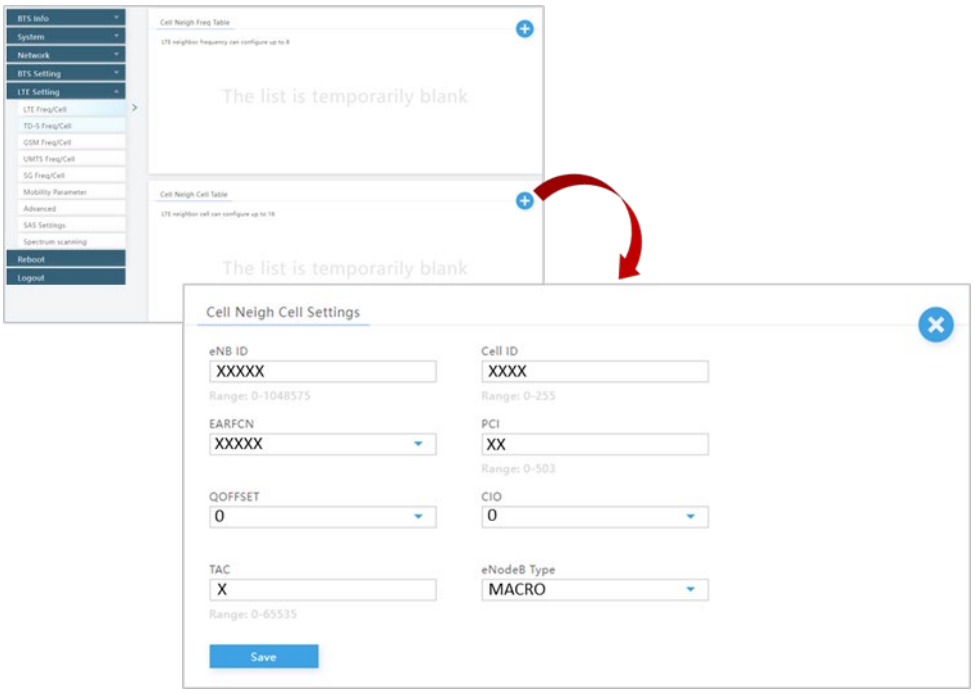


Figure 2-79: LTE Cell Neigh Cell Settings Example



Explanation of the event thresholds: The serving eNB starts the A2 and A3 event threshold measurements. If the A3 event threshold is met by a neighbor intra-frequency cell, the CPE session is handed off to that target eNB. If the A2 event threshold is met, it stops the A2 measurement and triggers the A1 and A5 measurements. Then, if the A1 event threshold is met, it stops the A1/A5 measurements and starts the A2 evaluation again. Assuming the A5 measurement indicates the neighbor inter-frequency cell is better than the serving cell, the serving eNB hands off the session to the neighbor eNB.

Example: In the *A1 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the starting measurement for *LTE A1 RSRP Threshold* is set to 45 (Figure 2-80). If the CPE measures RSRP > -95 dBm, the CPE reports the A1 event and the network stops the A1 and A5 event measurements. At that time, the network starts the A2 event measurement.

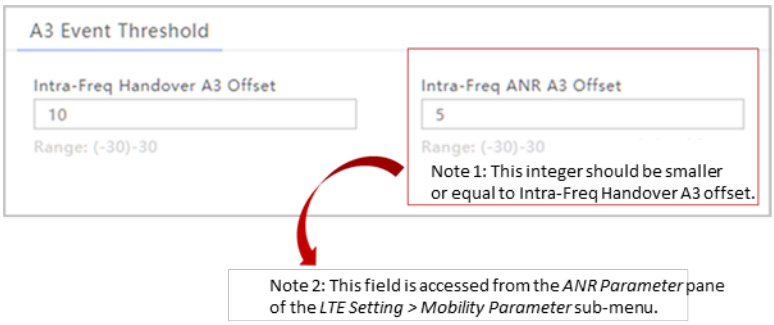
Figure 2-80: A1 Event Threshold

In the *A2 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the *LTE A2 RSRP Threshold* value is set to 40 (Figure 2-81). If the CPE measures RSRP < -100 dBm, the CPE reports the A2 event and the network starts the A1 and A5 event measurements.

Figure 2-81: A2 Event Threshold

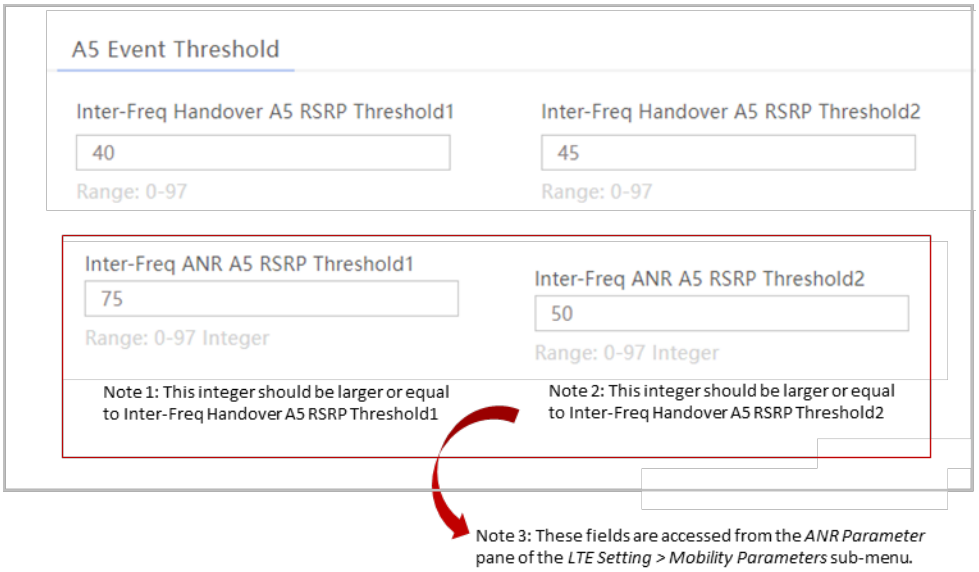
In the *A3 Event Threshold* pane of the *LTE Setting > Mobility Parameter* sub-menu, assume the *Intra-Freq Handover A3 Offset* value is set to 10 (Figure 2-82). If the CPE reports an A3 event (offset > 10*0.5 = 5 dB), the eNB may command the CPE to hand off to the target intra-frequency cell.

Figure 2-82: A3 Event Threshold



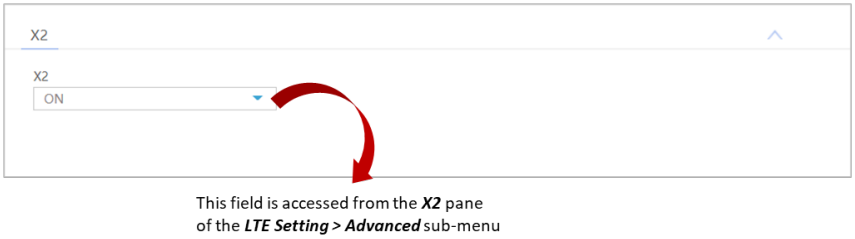
For the *A5 Event Threshold* pane of the *LTE Setting > Mobile Parameters* sub-menu, assume the *Inter-Freq Handover A5 RSRP Threshold1* value is set to 40 and *Inter-Freq Handover A5 RSRP Threshold2* value is set to 45 (Figure 2-83). If the CPE reports an A5 event (RSRP of the serving cell < -100 dBm, and the RSRP of the neighbor cell is > -95 dBm), the eNB may command the CPE to hand off to the target inter-frequency cell.

Figure 2-83: A5 Event Threshold



Assume that *X2* is enabled (Figure 2-84). To ensure X2 handover is successful, the MME must support eNB configuration transfer and MME configuration transfer S1 message handling.

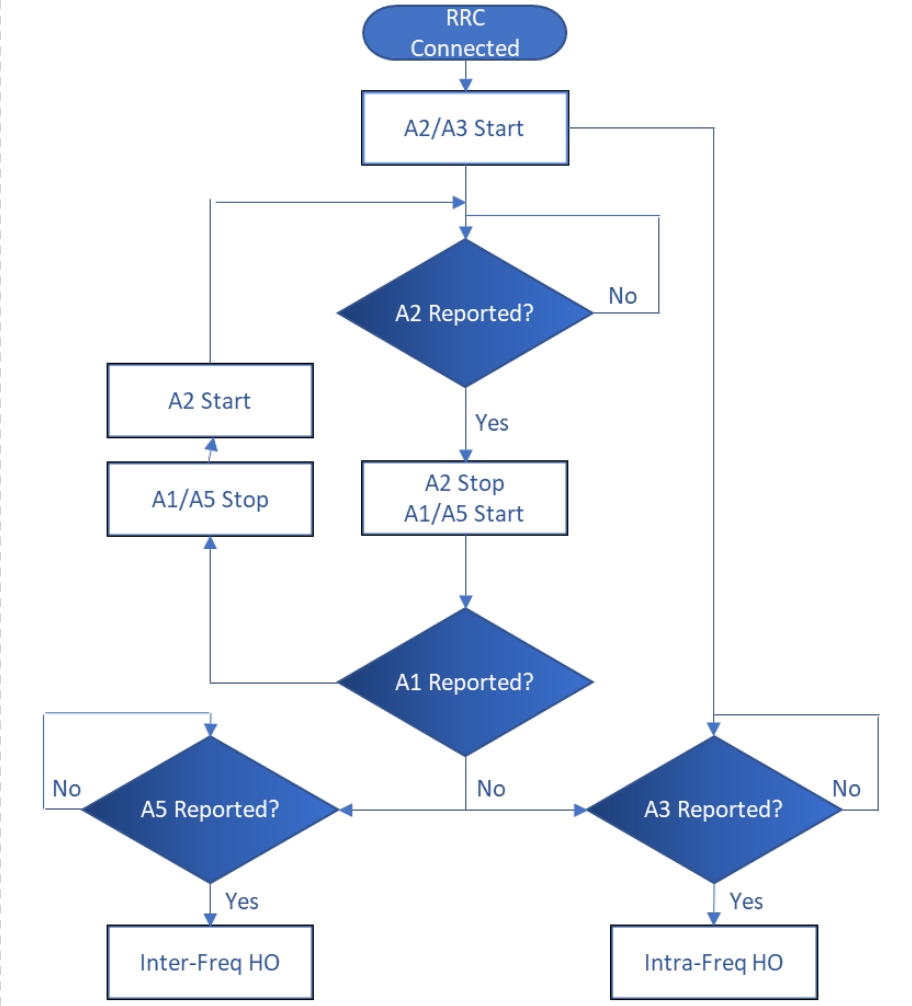
Figure 2-84: X2



With any changes to these configuration parameters, perform a reboot of the eNB for the new configuration to take effect.

The chart in Figure 2-85 shows the flow of these handoff event thresholds.

Figure 2-85: Flowchart of Handoff Event Thresholds



Event A1: The serving cell becomes better than the absolute threshold.
Event A2: The serving cell becomes worse than the absolute threshold.
Event A3: The neighbor cell becomes "x" amount of offset better than the serving cell.
Event A5: The serving cell becomes worse than the absolute threshold 1 AND the neighbor cell becomes better than another absolute threshold 2.

2.10 Reboot

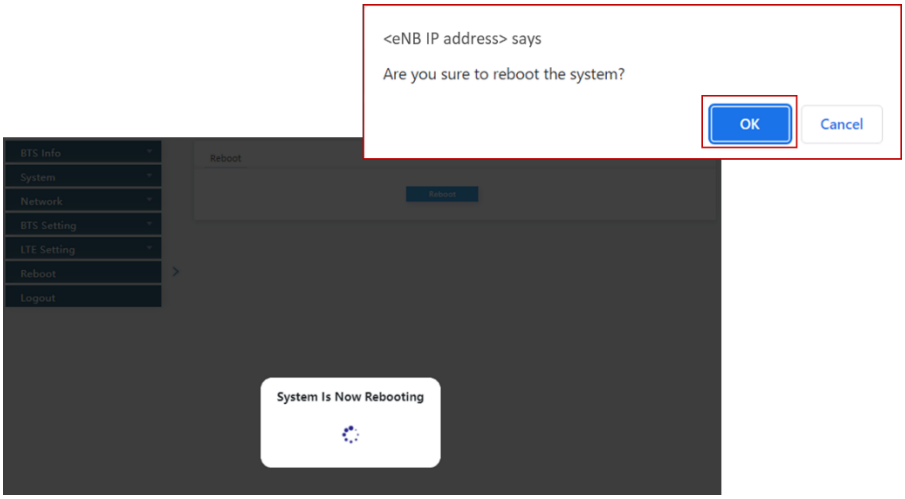
To reboot the eNB go to the *Reboot* menu and click *Reboot*. Confirm intent to reboot by clicking *OK* at the message prompt (Figure 2-86).

Caution: The reboot action disrupts eNB service.

NOTE 1: When you need to reboot the eNB, Baicells recommends that you collect logs on the eNB before you reboot it. That data may be needed for troubleshooting.

NOTE 2: In a lab test environment, you can disable GPS Sync setting to reduce the reboot time. The GPS Sync setting is enabled and disabled in the *BTS Setting > Sync Setting* sub-menu (*section 2.7.3*).

Figure 2-86: Reboot Menu



2.11 Logout

To log out of the eNB GUI, click on the *Logout* menu shown in Figure 2-87. You are automatically logged out of the GUI and presented with the login screen.

Figure 2-87: Logout Menu